Abstract

DNA studies at 900 MHz EM fields by a TEM plane transmission line

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Abstract

In recent years, due to the large diffusion of electric devices like cellular phones and their base station antennas, the exposure level of worldwide population to electric and magnetic fields has grown by orders of magnitude. This evidence pose the urgent problem to adequately evaluate the risks related to the widespread use of these technologies.
In this study, utilizing a suitable irradiating transmission line chamber, the effects of 900 MHz radio frequency fields on DNA mutability and repair in *Escherichia coli* strains were investigated.
The transmission line was very versatile and able to easily apply different field values. In this experiment the maximum electric and magnetic fields were 66 V/m and 260 nT, respectively, in the absence of cell plates. Slight decrease in spontaneous mutability to erythromycin and rifampicin-resistance was demonstrated in mismatch-repair proficient bacteria exposed to the radio frequency electromagnetic field (RF-EMF) during their growth on solid medium. The anti-mutagenic effect of the RF-EMF was much more impressive at the level of a hypermutagenic cytosine repeat, whose stability is strongly dependent on the activity of the mismatch repair system. In contrast, in mismatch repair-defective background RF-EMF neither affected the general DNA mutability nor the stability of the cytosine repeat, suggesting that the anti-mutagenic effect of the 900 MHz RF-EMF might be due to an improved efficiency of the mismatch repair system.

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Experimental analysis of a TEM plane transmission line for DNA studies at 900 MHz EM fields.
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Application of $XeCl_{308nm}$ excimer laser radiation to mutate industrial microorganisms

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Abstract

Bacteria are excellent producers of several potent bioactive compounds. Many of the products currently used for human or animal therapy, in pharmaceutical and food industry and in agriculture are produced by microbial secondary metabolism, or are derived from chemical modification of a microbial product. However, it is rare for these microorganisms to produce biological molecules at concentration so high as to initiate the production on an industrial scale. Therefore, an important challenge in industrial microbiology is to improve the secondary metabolites production by microorganisms.

Mutation-selection procedures are widely used in biotechnology to improve the performance of producer microorganisms. Mutation protocols rely on chemical mutagens or physical mutagens including ultraviolet light (UV). When short wavelength radiation strikes biological material, DNA is damaged and this damage can cause cell killing, can be repaired or can cause mutagenesis.

UV_{254nm} lamps are widely used in mutagenesis-selection protocols to isolate mutants with a desiderate phenotype for research or industrial purposes. The mutagenic effect of near-UV radiation is due to the presence of a functional error-prone DNA repair system. However, many producer microorganisms are naturally lacking of this repair system and thus

insensitive toUV_{254nm}-induced mutagenesis.

Recently, we have demonstrated that, at a variance with the UV_{254nm} mutagenesis, the UV_{308nm} mutagenesis by $XeCl_{308nm}$ excimer laser is errore prone system-independent, suggesting that the UV_{308nm} might be mutagenic also in microorganisms naturally lacking of this system repair.

In this study, we have developed an innovative mutagenesis protocol based on a homemade $XeCl_{308nm}$ excimer laser and have demonstrated its efficiency on mutagenesis of *Nonomuraea* ATCC 39727, an industrial strain producing an antibiotic, which is relatively refractory to UV_{254nm} radiation-induced mutagenesis.

This experimental approach is of wide interest because, in contrast to far-UV_{254nm} radiation, the environmental radiation band around 308 nm is only partially attenuated by the atmosphere and has a potential impact on biological systems.

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DNA damage by a single intense shot of soft X-rays emitted by a laser-produced plasma

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Abstract

A single-shot damage induction to plasmid DNA was demonstrated by applying X-rays emitted by a laser-produced plasma. Yields of single-strand breaks and double-strand breaks were determined as a function of energy fluence which was adjusted by varying the distance of the exposed sample from the X-ray source and by thickness of Al filters attenuating X-rays. As an intense source of X-ray radiation was employed a double-stream gas puff target irradiated by sub-kJ, near-infrared (NIR) focused laser pulses at the PALS facility (Prague Asterix Laser System) to produce high-energy pulses of soft X-rays from hot, dense Xe plasma. The double-puff arrangement ensures high gas density and conversion efficiency from NIR to X-rays approaching that typical for solid targets. In addition, its major advantage over solid targets is that it is debris free and has substantially suppressed charged particle emission.

Study of the effect of new vascular damaging agents for cancer therapy by Fluorescence Lifetime Imaging (FLIM)

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Abstract

It is well known that the origin of most diseases can be found at molecular level, and in particular in the impairment of the chemical machinery that manage the production of proteins inside cells. Recent advances in molecular and cell biology and the ability to decode entire genomes gave the chance to develop smart probes that address the molecular bases of many diseases. Thus, using suitable imaging systems capable of detecting such probes in living cells, in living animals and, potentially in the human body, the onset of a disease, can be revealed as early as any change at molecular lever takes place. The combination of specific markers with imaging systems operating *in vivo* represents the new concept of Molecular Imaging. Optical methods and in particular fluorescence techniques provide simple, reliable and cost effective ways to apply the Molecular Imaging concept. Different approaches can be followed in order to discriminate the signal of the marker from the background fluorescence and to model the propagation of photons in highly scattering media. Fluorescence Lifetime Imaging (FLIM) can be applied to improve the signal to noise ratio, while theoretical models of photon migration based on the diffusion approximation can be applied to recover the localization and concentration of markers from the measurements of the light fluence exiting the surface of small animals. The experience of the biomedical optics group at the Physic Department of Politecnico di Milano concerning fluorescence imaging with small animals will be presented. In particular, the presentation will address the study of the effect of new vascular damaging agents for cancer therapy in mice and the development of innovative tomographic devices for fluorescence imaging in small animals.

Fisica, scienze esatte e medicina a servizio dell'uomo: cambiano i tempi e i paradigmi, ma rimane l'eterno anelito !

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Sommario

Nel corso della suo incedere ultra-millenario, la medicina ha fatto progressi solo quando si è potuta avvalere del contributo delle scienze esatte e sperimentali (matematica, fisica, chimica, biologia, etc). Da qui emerge, sempre più anche nei giorni nostri, l'anelito di considerare la medicina come scienza della vita – un mixing di discipline scientifiche, piuttosto che un'arte come definita per anni e anni - che ambisce a curare le persone.

Grazie alle scienze esatte, in medicina, si è potuto illustrare i processi (anatomici, fisici, chimici, biologici, fisiologici, biochimici, etc) che sono alla base del funzionamento fisiologico del "corpo umano" nonché il suo malfunzionamento (fisiopatologia) fino agli stati patologici di questo o quell'organo, di questa o quella funzione. Peraltro nella scienza medica, anche se lentamente, si è radicato il metodo galileiano che impone di *misurare ciò che è misurabile*. Il medico dei nostri giorni non è più un'isola né "un'artista" in quanto oggi elabora ipotesi diagnostiche, prognosi e terapie sulla base di parametri anatomici, metabolici, funzionali, farmacologici, a volte meccanici, tutti accuratamente documentabili, misurabili e quindi applicabili. I processi di intuizione e di deduzione mentale non sono scomparsi in medicina, ma da essi non si dipende più *in toto*.

La complessità degli apparati tecnologici che permettono di effettuare misure sul corpo umano hanno di fatto cambiato la pratica della medicina e soprattutto della ricerca medica crescere bene, nei contesti virtuosi, solo in ambienti multidisciplinari, dove il contributo di tutte varie professionalità (medici, biologi, infermieri, fisici, ingegneri, informatici, economisti, epidemiologi, managers, tecnologi, tecnici, etc) è integrato, sinergico, arricchente, parimenti importante oltre che irrinunciabile per curare al meglio. Oggigiorno, se si vuole garantire un'offerta di salute adeguata alle richieste e alle esigenze di una società che ci tiene ai propri cittadini (processi di cura più veloci, meno invasivi, con costi sostenibili, e capaci di ripristinare una qualità della vita accettabile), bisogna necessariamente seguire tale approccio, pena lo sfascio dei sistemi e l'insoddisfazione.

Fra i tanti progressi registrabili, un'idea concreta e di grande visibilità, che esprime bene il contributo delle scienze fisiche allo sviluppo della medicina sperimentale e alla medicina clinica è data dal mitico settore dell'**imaging biomedico,** altrimenti detto in modo riduttivo viste le recenti acquisizioni, **diagnostica per immagini** che non è l'unica parte innovativa della medicina. Essa è di certo quella che ha beneficiato maggiormente degli straordinari avanzamenti scientifici nella conoscenza della materia e dei suoi costituenti fondamentali che si sono registrati nella prima metà del'900. Infatti, l'introduzione della fisica quantistica e lo sviluppo tecnologico che ha favorito tali avanzamenti (tuttora in tumultuoso corso) ha fatto passare la diagnostica per immagini da strumento "rudimentale" di diagnosi (radiografia tradizionale) a settore cruciale per effettuare prevenzione, diagnosi, valutazioni prognostiche e follow up di moltissimi casi di malattie, fatto salvo il rischio dell'appropriatezza, come nell'uso scriteriato che si sempre più facendo della TAC multistrato.

All'orizzonte, si profilano, fra i tanti in corso, straordinari progressi in tema di:

a) *interventistica minimamente invasiva* che sfrutta i progressi in tema di laser, ultrasuoni, micro-nano-particelle, risonanza magnetica, radiologia, etc;

b) *imaging molecolare* che esplicita la biologia e la patologia su scala molecolare.

In medicina, il concetto di filiera ***(Imaging Therapy Continuum)*** prevede l'utilizzo di immagini e segnali in ogni fase della malattia, al fine di ottenere quella varietà di informazioni strutturali, emodinamiche, metaboliche, biochimiche, fisiche e molecolari che possono, se usate in modo competente, garantire un'assistenza di qualità. Pertanto, la clinica (che deve generare stimoli e domande di ricerca) e le scienze esatte devono crescere e progredire assieme per dare - con la formazione adeguata e con le tecnologie appropriate (Raggi X, Ultrasuoni, Risonanza Magnetica, PET, SPECT, Optical Coherence Tomography, Laser) - le risposte giuste, minimamente invasive, ubiquitarie, a costi sostenibili e disponibili per tutti. Così, insieme, si può dare una buona assistenza!

Laser application in oral surgery

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Abstract

The increasing use of lasers in oral surgery has resulted in many advantages that have contributed to improve the quality of interventions in outpatient compared to the electro-scalpel and a blade cold scalpel. The dental laser allows to obtain a better accuracy of the engraving line, easier healing, reduction of bleeding, reduction of working time, reduction of edams a post-operative, no pain, sterility and scarring wound processes more aesthetic.The laser operation favours also a bio-stimulation of the cells that are activated in healing of the wound, speeding up the process. It has a decontaminating effect of germs inside the root canals and in the wound caused by viruses, bacteria and fungus.The multiple applications of laser in dentistry make it an indispensable tool, which improves the quality of performance and optimize the activities of the dental study. Therefore, I believe, the dental laser may be considered a viable alternative to conventional surgical therapies while providing multiple benefits with minimal invasiveness.

Nitric oxide photoinduced release from Langmuir-Schaefer organic thin films

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Abstract

Nitric oxide (NO) plays a pleiotropic role in the bioregulation of a wide range of pathophysio- and physiological processes including vasodilatation, neurotransmission, hormone secretion, macrophage-induced cytotoxicity [1], anticancer processes.[2] This multifaceted role of NO has stimulated an explosion of interest devoted to developing compounds which can serve to deliver NO. The main problem associated with NO donors is the precise spatiotemporal control of the NO released. In this context, light is an appealing external on/off trigger to accurately regulate the NO dosage. The compound used in this work is the cationic amphiphile **1** (figure 1) which incorporates a nitroaniline derivative that we have discovered to be a

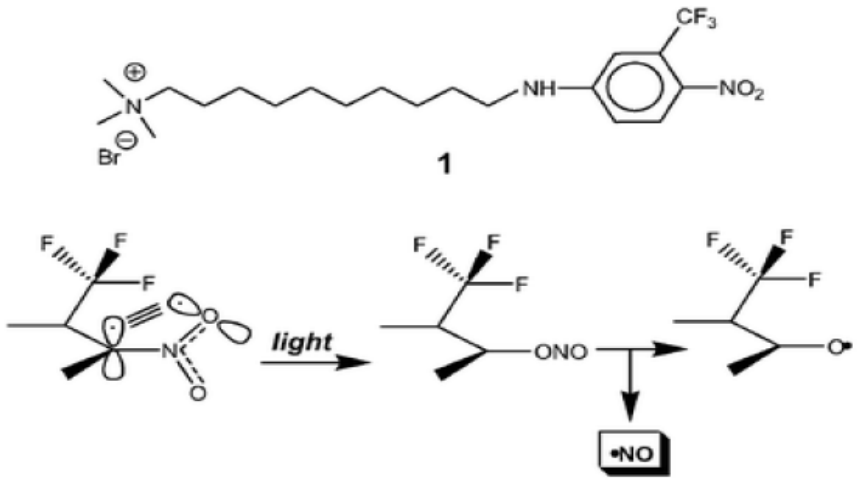

Fig. 1. The molecular structure of **1** and the mechanism of NO photorelease.

suitable NO photodonor under visible light irradiation.[3] Due to its amphiphilic characteristics, **1** is well-suited to the preparation of multilayer films through Langmuir–Schäfer (LS) techniques. Due to the presence of the CF_3, substituent the nitro group is placed almost perpendicularly to the aromatic plane. This out of plane geometry makes the p orbital of the oxygen atom have a constructive overlap with the adjacent p orbital of the aromatic ring in the ground state. Such a twisted conformation is crucial in triggering the NO photorelease which takes place through a nitro to nitrite photorearrangement followed by the rupture of the O–NO bond leading to the concomitant generation of NO and a phenoxyl radical. [4] We have extensively demonstrated that the pathway leading to NO release is locked if planarization of the nitro group occurs, for instance upon the confinement of the chromophore in a restricted microenvironment. In light of this, the rigorous control of the molecular conformation of **1** during the multilayer fabrication is crucial to ensure NO photodelivery.

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LAMQS, EDXRF and SEM analyses of old coins

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Abstract

Physical analyses by Laser Ablation coupled to Mass Quadrupole Spectrometry (LAMQS), Energy Dispersive X-Ray Fluorescence (EDXRF) induced by electron beam and SEM (Scanning Electron Microscopy) morphological investigations have been employed, as not destructive analyses, in order to characterize the surface of different old coins. Gold, silver and bronze old coins have been studied to know their superficial patina composition and morphology. In particular LAMQS permitted to investigate the elemental, chemical compounds composition and isotopic ratios without damage the laser irradiated surface.

By using archeological data, the comparison of similar old coins may permit to identify the provenience site and to characterize the original mineral used for their manufacture. Moreover, the analysis comparison permits distinguish between true and false samples, so as demonstrated for different Greek silver coins presented in this article.

Short Soft X-Ray Sources

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Abstract

It is demonstrated that laser-induced plasma is a very efficient generator of soft X-ray that has a high interest for applications in lithograph, sequencing of DNA and living cell studies [1]. In this work, a fast Faraday cup (FC) equipped by an X-ray filter is utilised to diagnostic the X-rays. The plasma was generated by a KrF excimer operating at 248 nm and 23 ns. The laser energies utilized were 40, 80 and 120 mJ and the laser spot was approximately 0.01 cm^2. The metal target utilised were made of Cu, Si and Ta.

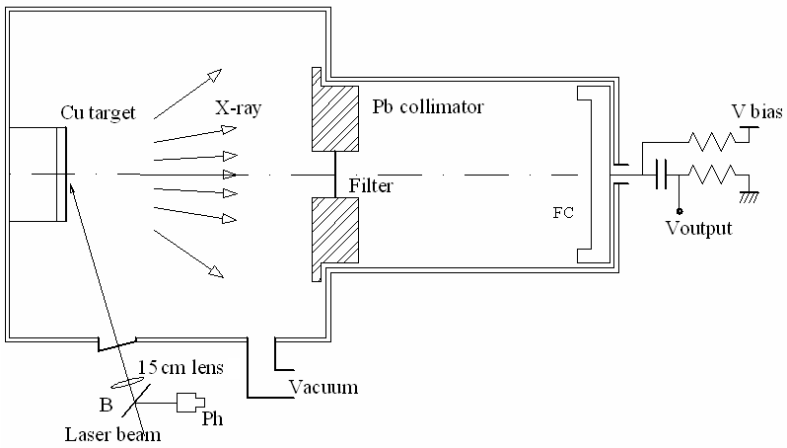

Fig. 1. Experimental set-up. B: beam splitter; Ph: photodiode; FC: Faraday cup.

Fig. 1 shows the experimental apparatus. The X-rays, provided by the laser-plasma, strikes the internal walls of the chamber and the FC collector and electrons of different energy are emitted. The cup signals can be positive or negative depending on bias polarity and electron energy. A collimator was placed in front of the cup because the electron emission from the chamber walls does not favour a good diagnostic of the X radiation. To characterize the X-rays, we suppressed the electron emitted from the cup collector by polarising the cup at a trapping positive voltage. The electron currents decrease as the trapping voltage increases. Measurements of the X-rays energy were done by means of a filter of 0.2 μm thin deposited on 1 μm C3H6. Comparing the X-rays percentage reduction with the attenuation coefficient of the filter we calculated the X-rays energy. The X-rays energy was less than 200 eV. The obtained results are comparable with the ones found by the FC.

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Evidence of Photoinduced Charge Transfer Phenomena in Fulleropyrrolidine-Porphyrin LS Films

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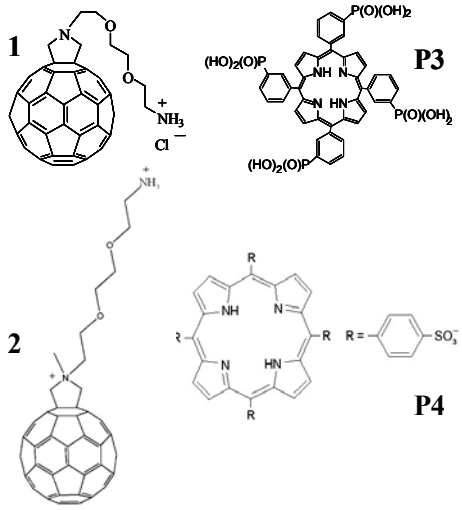
Abstract

The observation that C_{60} is a powerful electron acceptor has rendered the use of [60]fullerene almost unique in conjunction with electron donors. The structures of two different [60]fullerene derivatives (**1** and **2**) and two different water-soluble porphyrins (**P3** and **P4**) used in this research are herewith illustrated. Films containing the dyad **1/P3** were prepared by the Langmuir-Schäfer method[1, 2]. of **1** at the air-water interface have been registered for both pure water and subphase containing soluble **P3**. Langmuir curves, Brewster Angle Microscopy (BAM) investigation and UV-vis Reflection Spectroscopy on the water surface have revealed that the introduction into the subphase of **P3** featured considerable influence on the structure and morphology of the floating layer. The same conclusions can be drawn for the dyad system **1/P4** and the other one containing the derivatives **2** and **P4**. Then, photocurrent experiments on monolayers on ITO-covered glass substrates were carried out measuring the response of light illumination on the generation of electrical energy. A nonconventional approach to photoinduced phenomena for the dyads **1/P4** and **2/P4** is proposed by differential spectroscopy in the FT-IR attenuated total reflectance (ATR) mode. During the illumination, the IR spectra shown band shifts at 1012 cm^{-1}, 1034 cm^{-1} and 1122 cm^{-1}, and it suggests that the sulfonate moieties of the **P4** are involved in an electron transfer [3]. Fluorescence spectroscopy has been employed in order to evaluate the quenching of the fluorescence of the **P4** when it is dissolved in ethanol using **1** and **2** as quenchers.



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Polymer modifications due to absorption of different ionizating radiations

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Abstract

In the last eight years, an useful collaboration was born between the material engineers and the physicians of Messina University. The study of the intimate structure of a material, before and after its modification induced by an external ionizing radiation source (electrons, ions, gamma) requires the simultaneous presence of specialist in Chemistry, Physics and Engineering in order to define the best modification conditions and the consequent features of the new synthesized material.

In particular the polyethylene (employed in different fields, such as microelectronics and biomedicine) was chosen as an important target to modify its properties through ions and electron beam irradiations.

Ion beams, with energy of the order of some hundred keV and doses of the order of $10^{14}/cm^2$, are able to improve its surface properties without change the pristine bulk mechanical resistance. Electron beams, with energy of about 5 MeV and high dose, improve the mechanical resistance of the bulk polymer.

The effects of the ion and electron modifications were investigated with several physics and mechanical characterization methods, as will be discussed in the following.

An epitaxial contact technology for novel X- and γ-ray detectors based on CdTe crystals

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Abstract

Cadmium telluride (CdTe) is one of the most promising semiconductors for the realization of nuclear radiation detectors operating at non-cryogenic temperatures, particularly for applications to imaging instruments and high performance spectrometers in reason of its high mean atomic number, large X/g-ray photon stopping power and wide band-gap (1.45 eV at 300K). CdTe-based detectors usually employ In or Pt thin films to form a Schottky barrier (In) or an ohmic contact (Pt) onto semi-insulating CdTe crystals. However, the need to apply high reverse bias voltages (for good charge collection efficiencies) leads to relatively high dark currents (10^{-7}-10^{-8} A/cm^2) and strong polarization effects. We propose a new CdTe detectors based on homoepitaxial p-i-n diode structures, where the intrinsic part of the device is a bulk CdTe crystal and the n-/p-doped parts of the diode are grown homo-epitaxially; p-i-n diode structures have the potential for very low dark currents under high reverse bias conditions [1].

This work investigates the use of metalorganic vapour phase epitaxy (MOVPE) for the growth of iodine-doped CdTe (CdTe:I) layers on detector-grade (111)B-CdTe crystals and fabrication of test Al/n-CdTe:I/i-CdTe/Pt device structure, a technological step towards the complete p-i-n homojunction diode structure.

CdTe:I homoepitaxial layers were grown in a atmospheric pressure horizontal MOVPE reactor on (111)B-oriented CdTe crystals. To ensure complete and reproducible homoepitaxy of CdTe on the (111)B surface of CdTe crystals, these went through a series of chemical and thermal surface treatments [2]. Homoepitaxial CdTe:I layers were then grown at temperatures between 330°C and 350°C. Incorporation of Iodine into CdTe layers was confirmed by SIMS analysis and low (7K) temperature photoluminescence (PL) measurements, and showed to increase for low Te:Cd precursor ratios in the vapour. CdTe:I layers showed electron concentration in the 10^{16} cm^{-3} range.

As-grown n-CdTe:I/i-CdTe homoepitaxial structures were used to fabricate preliminary M-i-n test devices: to this purpose, 2-μm thick CdTe:I epilayers were mesa-etched down to the substrate crystal using Br_2-methanol solution and deposited with a 200 nm thin Al ohmic contact; the device back surface (substrate side) was instead evaporated with a Pt contact. The device I-V characteristics showed a rectifying behaviour, with dark current values (under reverse bias conditions) about two orders of magnitude lower than for conventional Pt/i-CdTe/Pt detectors, and comparable to In/i-CdTe/Pt structures.

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Organic residues analysis on archaeological samples of pottery vessels by gas

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Abstract

In the framework of a collaboration between the Di.S.Te.B.A. Organic Chemistry Laboratory and the Department of Cultural Heritage of Salento University, organic residues analysis has been applied to different types of vessels from the archaeological site of San Vito dei Normanni (South Italy). The excavations carried out by the University since 1996 have discovered an indigenous settlement with a continuous occupation from the Iron Age until the end of the Archaic period, when the site was abandoned. The importance of the settlement, in particular during the VIth century b.C., is clear from the archaeological evidence. A big habitation area, several luxury goods, greek imported materials and numerous handmade local ceramics were recovered from the site.

The materials selected for chemical analysis are pots, jars and amphorae used for cooking meals or as food containers. Most of the vessels analyzed are imported cooking pots and trade amphorae, while the jars are locally produced. Organic residues were identified by gas chromatography coupled with mass spectrometry (GC-MS), respectively. GC-MS of lipid extracts of sherds has shown the presence of different fatty acids and other markers. In most cases there is a strict correlation between organic markers and shape of the vessels, while in other samples it appears that different ceramic containers probably served the same function. The results show that most of the cooking pots were used to boil meat, probably of ruminant animals. These data can be related with ritual practices and animal sacrifice, as we can suppose from the faunal remains and other materials recovered in the site. Most of the jars were instead used to cook vegetables, probably legumes and cereals, as confirmed by the botanical remains. Residues analysis of the amphorae revealed that they contained oil, probably olive oil, and wine.

Fast capacitive probe for short and high intensity electromagnetic pulses diagnostic

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Abstract

Fast and high intensity electromagnetic pulses are constantly request especially for FEL of new generation and other scientific and industrial machines. Nowadays fast current or voltage pulses of sub ten picoseconds can be recorded in real time by fast digitizing oscilloscopes. To get good results it is necessary realize fast probes. Fast capacitive probes are conceived like a transmission line and it is indispensable to construct it with electrodes of suitable dimensions and form. The instrument we realized has got the central electrode folded in order to present a skin dimension close to external electrode sides and a particular configuration for containing the integrating resistor to avoid electromagnetic interferences. It is suitable for measuring fast voltage and current pulses propagating in coaxial structures of known characteristic impedance. Analysing the behaviour of the probe for pulses propagating in a 50 Ω coaxial structure the voltage amplification resulted of $(3.6 \pm 0{,}1)\times10^{-4}$ and as a consequence the current attenuation factor of 56±1 A/V. The rise time response was very interesting. It was less than 350 ps, value limited by oscilloscope bandwave.

Modifica superficiale di polimeri da fasci laser UV e IR

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Abstract

In this work, laser irradiation to modify the morphology of the polymeric surfaces was utilized. Contact angle and roughness measurements in order to get information on the wettability were performed on the processed samples before and after the laser treatment. The samples treated were Poly(Methyl MethAcrylate) (PMMA) and Ultra High Molecular Weight Polyethylene (UHMWPE). Both are polymers employed in many fields for their good chemical-physics properties. The processing was performed by two different laser sources operating in the UV and IR range. The UV laser was a pulsed KrF excimer laser of 248 nm, 23 ns, while the IR one was a pulsed CO_2 laser of 10.6 μm, 30 ns. The samples processing was performed applying different laser shots in air atmosphere. In this work, we measured also the optical depth for our polymers at 248 nm and 10.6 μm. The optical length of the UHMWPE at 10.6 μm was of 1.5 mm. This large value did not allow to imprint modifications on the surface but rather under the surface. Interesting results were found with both utilized wavelengths the PMMA and with the UV radiation on the UHMWPE. Under our experimental conditions the higher change of wettability was observed by the UHMWPE sample with the UV radiation. It was of 8% at 50 laser shots of 0.6 J/cm^2.

Ion and electron generation by laser useful for radiotherapy and adrontherapy

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Abstract

Electron and ion sources are today utilized in several fields such as for medical applications in radiotherapy and adronterapy. In this work, results about a different and useful method to generate electrons and ions by laser irradiation is presented. The laser utilised was an excimer KrF, of 23ns pulse duration. The electrons were obtained by photoelectric effect from a metallic cathode, while ions were extracted by plasma produced by laser ablation. The produced beams were characterized by low emittance. In the case of electrons, the current density extracted by smooth and rough cathodes was studied, and it was found that a roughness surface increases the electron extraction. About the ions, it was possible to accelerate them up to 150keV per charge state through a compact accelerator realised in the LEAS laboratory in Lecce. This device consisted of an expansion chamber where the plasma was produced. In front of the chamber an electrode connected to ground and a collected support were placed. The expansion chamber and the collected support were put at high DC voltage of different polarity, in order to create an acceleration field between the chamber and the support.

Ion implantation of biomaterial by different ions using a LIS accelerator

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Abstract

Ultra-high-molecular-weight-polyethylene (UHMWPE) is nowadays utilized in many fields, such as bio-medicine, engineering and microelectronics due its excellent chemical and physical properties. Nevertheless, the polymer employed in mobile prosthesis suffers, along the time, the friction against hard surfaces inducing alterations of UHMWPE.Ion implantation is a good tool to modify the surface characteristics of the polymer in order to reduce the friction wear increasing the whole prosthesis device lifetime.In this work, an improvement of the wear resistance of UHMWPE is attempted by using ion implantation technique induced by carbon laser-generated plasma.Recently also different stainless steel samples have been implanted to get antibacterial surfaces.

Laser Cleaning applied on a silver *Carlino* coin

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Abstract

Ancient artefacts of Ag as well as of Ag/Cu alloy present black colour due to formation of acanthide (Ag_2S) and jalpaite (Ag_3CuS_2) patina. Laser cleaning can be utilised to remove the patina. In this work we applied the laser cleaning to a silver coin "*carlino*" dated 1689 coined in Spain during the domination of Carlo II. Before the operation, it was necessary to know the threshold fluence in order to avoid the destruction the artefact. A laser KrF 248 nm, 23 ns was utilised. The threshold values found were of 500 and 780 mJ/cm2 for the Ag/Cu alloy and Ag, respectively.

Proton acceleration by laser-generated plasma for nuclear applications

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Abstract

A Nd:Yag laser is employed to generate pulsed plasma at LNS of Catania and to extract proton ion beams. The laser ion source (LIS) uses hydrogenated materials (hydrides, hydrogenated polymers, etc…) for laser ablation at 800 mJ pulse energy, 9 ns pulse duration, 30 Hz repetition rate and 1 mm^2 spot size. Plasma expansion occurs in a region of the order of tens centimetres accelerating ions at energies of the order of 100 eV, as demonstrated by time-of-flight (TOF) measurement. An extractor permits to extract ions accelerated by an electric field of the order of 10 kV/cm. The pulsed ion beam can be successively focused, collimated and filtered in order to obtain monoenergetic ion beams. High ion current can be reached without collimation and filtering using large energy spreader beams. Possible applications in nuclear physics of accelerated deuterium beams, at energies above 10 keV, hitting deuterated targets to induce D-D nuclear fusion processes will be studied.

Biomateriali in Ortopedia

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Sommario

The development of new materials of interest for application in orthopedic have grown in the last years. The new materials are ; metallic, ceramic and polymeric. Generally, due to characteristic of the metal, these last are covered by idrossiapatite that they evidences remarkable advantages with respect to systems with same design and the same metallurgical characteristics. In the orthopedic field they are remarkably used polymers like UHMWPE (Ultrahigh-molecular-weight poly (ethylene) and the PMMA Poly (methyl methacrylate). These materials have revolutionized prosthetic surgery of the hip, the prosthetic of knee and the other. In this work the last application will be presented.

Ge ION IMPLANT FROM ENERGETIC LASER-GENERATED PLASMA

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Abstract

At the PALS laboratories of Prague and IPPLM of Warsaw experimental tests have been carried out to implant Ge ions in Si substrates through Ge-plasma laser-generated. Si substrates were exposed in a vacuum at different distances from the Ge-target and at different angles with respect to the normal to the target surface. The plasma-laser has been produced from 2 different kinds of laser: iodine laser, 1315nm, 38 J, 400ps pulse duration (at PALS laboratory) and a Nd:YAg laser, 1064 nm, 550 mJ, 3 ns pulse duration (at Warsaw laboratory). Online measurements of ion energy were obtained by time of flight (TOF) techniques using an ion energy analyzer IEA which permitted to draw information about the charge states and the Ge ion's energies. Off-line measurements were obtained by Rutherford backscattering spectrometry (RBS) of 2.25 MeV He^{2+} beam at CEDAD Laboratory of Brindisi. RBS analysis permitted to evaluate the Ge implant in Si substrate in terms concentration and ion depth profile. Moreover, the RBS spectra have given information about ion yield and energy as a function of the distance from the target, laser energy and angular position.

Results indicated that ion implants show high Ge ion energy and typical deep profiles only for substrates placed very near to the normal to the target surface and for high laser pulse intensity, while for low laser intensities and/or for substrates far from the normal to the target there is only a Ge deposition effect.

Esperimento di ‘charge breeding’ con cannone elettronico a catodo cavo

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Abstract

Il ‘charge breeding’ è in dispositivo, usato nella produzione di fasci radioattivio (RIB) con la tecnica ISOL (Isotope Separation on Line), che incrementa lo stato di carica di ioni 1+, in esso iniettati, fino a n+. Tale dispositivo è utilizzato per ottimizzare e ridurre i costi della riaccelerazione degli elementi radioattivi prodotti da un fascio primario. In alcuni esperimenti possono essere richiesti RIB continui ad una certa energia. Il dispositivo di ‘charge breeding’ basato su sorgenti di tipo EBIS non può raggiungere un funzionamento in continua in quanto gli ioni con alto stato di carica n+, prodotti nella trappola EBIS, sono estratti dalla stessa parte da cui sono iniettati gli ioni 1+, ossia, dal collettore di elettroni. In questa proposta, si prevede di usare una EBIS con cannone elettronico a catodo cavo per provare a realizzare un ‘charge breeding’ che abbia la possibilità di funzionare anche in continua, con un duty cycle più elevato. Infatti un sistema di iniezione degli ioni 1+ dalla parte del catodo dovrebbe permettere oltre ad una maggiore facilità di estrazione degli ioni n+ anche la possibilità di raggiungere, almeno in linea di principio, il funzionamento in CW.

TOF ION SPECTRA DECONVOLUTION FOR LASER-GENERATED PLASMAS

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Abstract

A study of different targets (CH_2, Al_2O_3,Fe, Ni, Ti) ablation, in vacuum, by using a 3 ns Nd:YAG laser radiation, 1064 nm and 532 nm (second harmonic) wavelengths, is reported. Laser pulse with high intensity generates a plasma at the target surface, with high non-isotropic emission of neutral and ion species, mainly emitted along the normal to the target surface. Time of flight (TOF) measurements are performed by using an ion collector consisting of a collimated Faraday cup placed along the normal to the target surface and an Ion Energy Analyzer (IEA) detector. The TOF spectra are converted as a function of the ions velocity and energy and they are deconvolved for the various ion charge states by using the "Coulomb-Boltzmann shifted" function approach through the "Peakfit" code. The fit of the experimental distribution data permits to estimate the equivalent plasma temperature and the average energy shift of the distributions as a function of the ion charge state. This energy shift leads to the evaluation of the electric field producing the ion acceleration inside the plasma.

Soft X-ray Microbean Layout Using a Plasma Source

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Abstract

In this article we present the analysis of a microbeam project in the soft X-ray energy region using a plasma source, which operates in the PLASMA-X laboratory of the Physics Department of L'Aquila University. In this work, we discuss the reasons that led to the design of the apparatus. Will describe the main features of the project.