Oral Communications Afternoon (16h - 17h45)

LASERS, DEVICES AND APPLIED OPTICS

[13/05/10 - 16h00 - Room 5]
Blue Diode Pumped Solid State Laser for Short Pulse, Large Bandwidth Ti:Saphire Pumping, Gustavo B. Nogueira, Fabíola A. Camargo, Jonas J. Neto, Renato J. R. Vieira, Niklaus U. Wetter, *Instituto de Pesquisas Energéticas e Nucleares - IPEN - São Paulo* ■ Blue lasers have attracted much attention for applications such as high-density data storage, color display, high-resolution printing, medical diagnostics and other interesting applications such as the atomic clock and pumped source for Ti:saphire. The absorption peak of Ti:saphire is centered in 488nm which is close to the second harmonic (473nm) of the Nd:YAG $^4F_{3/2} \rightarrow {}^4I_{9/2}$ transition.

One of the difficulties in using Nd:YAG is its strong thermal lens and the absence of a polarized beam, which decrease the second harmonic generation (SHG) efficiency. In order to minimize the thermal lens effect, a Nd:YAG with diffusion bonded end-caps was used together with a pump wavelength of 803nm, detuned from the absorption peak (808nm), providing a better temperature distribution inside the crystal.

First, the emission at the fundamental wavelength of 946nm was studied using a 1.7cm long cavity with different input mirrors (radii (RC) of 50mm,100mm and 300mm) and a flat output coupler mirror with 7.3% transmission. Different pump diameters were analyzed to experimentally obtain the best pump to laser mode diameter for this quasi-three level laser. A maximum output power of (7.17±0.18)W was obtained for 17.65W of absorbed pump power with a pump mode waist of 118mm, resulting in 49% slope efficiency. A RC = 100mm mirror was used, which provides a calculated laser mode waist (TEM_{00}) of w_L = 80mm inside the crystal.

Blue emission was obtained by intracavity second harmonic generation using two LBO type I (ooe) crystals with cross-sections of $3x3mm^2$ and different lengths (10mm and 15mm). The resonator length was increased to 3.5cm and 4.0cm, when used a 10mm long LBO and 15mm long LBO respectively, and the flat output coupler was replaced with a high reflector at 946nm, anti-reflection coated at 473nm. An output power of (230.0±2.3)mW at 473nm was obtained by using a 15mm long LBO crystal and (211.0±2.1)mW using a 10mm long LBO.

Due to the thermal lensing effects, the resonator was instable and changed frequently to multi-mode. Better results should be obtained using our newly acquired Nd:YAG crystals that have the HR coating directly applied to the polished surface and therefore can be placed into the resonator focus. To further improve the blue power we intend to test cavities that decouple the blue from the fundamental such as L and Z configurations. In these configurations, a smaller waist in the nonlinear crystal will provide also a better SHG efficiency.

[13/05/10 - 16h15 - Room 5]
Random laser with external feedback in very thin polymer films doped with rhodamine 6G and silver nanoparticles, C. Tolentino Dominguez, R. L. Maltez, L. S. A. Melo, A. S. L. Gomes, *Universidade Federal de Pernambuco, Departamento de Física, Cidade Universitaria, Recife, PE, 50670-901, Brazil*, R. L. Maltez, R. M. S. dos Reis, *2Universidade Federal do Rio Grande do Sul, Instituto de Física, C.P. 15051, Porto Alegre, RS, 91501-970, Brazil.* ■ In this work we present random laser emission from thin polymer films (about 20 μm) of Poly(methyl methacrylate) (PMMA) containing rhodamine 6G (R6G) dye laser and Ag nanoparticles (NPs) as scattering centers in several concentrations. Random laser is a random amplification media where the cavities are replaced by scattering particles, usually dielectric TiO_2 with a size comparable to the pumping wavelength. Above an energy threshold, the emission light shows high gain and a drastic reduction in the linewidth to a few nanometers, however it is omnidirectional. The coherent feedback in polymer films containing dielectric scatterers is achieved due to local fluctuations in the sample refractive index. In this study, we have used metallic NPs instead of dielectric ones. In addition to localized refractive index fluctuations, metals strongly scatter visible light due to localized surface-plasmon resonance (LSPR). As a further consequence of the LSPR, it is still possible that the confined electric field around the NP surface can directly excite a dye molecule in the PMMA, thus providing a higher optical gain for laser oscillation. Our films were fabricated by depositing a solution of PMMA containing silver nanoparticles and rhodamine 6G on a silicon substrate. The silver nanoparticles were obtained in an aqueous solution from a chemical reaction of $AgNO_3$ which was followed by two hours of laser ablation. A highly reflective aluminum mirror was deposited in between the PMMA film and the silicon substrate to increase the reinjection of transmitted photons. Our experimental results show a strong dependence of the emission on the concentration of Ag nanoparticles. For comparison purpose, samples with a typical concentration of TiO_2 were also prepared and no evidence of random laser was obtained. This demonstrates that a higher optical gain for lasing is obtained using Ag NPs in the case of very thin PMMA film.

[13/05/10 - 16h30 - Room 5]
High sensitivity differential refractometer by evanescent wave in a thin dielectric waveguide, Sérgio C. Zílio, Rafael A. S. Ribeiro, *IFSC/USP - SP - Brasil* ■ The index of refraction, IR, is an important physical parameter that determines most of the optical properties of a given material. There are several well-known techniques to measure the IR of gases and liquids, including those based on thin films. In this work, the m-line technique is modified for the development of a high sensitivity differential refractometer able to follow smalls IR variations of gases and liq-

uids due to chances in environmental conditions. The method is based on the excitation of guided modes in a planar waveguide. The system consists of a semi-cylindrical optical coupler coated with a double-layer thin film stack, one of SiO2 and the other of low-loss ZrO2, with thicknesses of 800 and 65 nm, respectively. The light source is a linearly polarized He-Ne laser operating at 543.5 nm. The sample is considered to be a semi-infinite medium in contact with the ZrO2 film. The radiation reflected from the ZrO2 film interferes with that coming from the optical coupler base, resulting in an interference pattern that shifts when changes of sample IR occurs. This shift is detected by a CCD camera and processed by acquisition software that calculates the positions of the fringes as a function of the sample IR. For instance, IR variations of air were measured due to changes in temperature, relative humidity and pressure, and then compared with values given in the literature. The system is able to measure variations due to relative humidity between 20 and 95

[13/05/10 - 16h45 - Room 5]
Development of a Mueller Matrix Optical Coherence Tomography System, Marcus Paulo Raele, Marcello Magri Amaral, Nilson Dias Vieira Jr., Anderson Zanardi de Freitas, *Instituto de Pesquisas Energéticas e Nucleares, IPEN - CNEN/SP* ■ Optical Coherence Tomography (OCT), is a technique based on low length coherence interferometry which can perform tomographic images of live structures. Mueller Matrices are mathematical elements which describes how a media alter the polarization state of the incident light. Differently of the Jones formalism for polarized light, Mueller Matrices can cope with unpolarized light and with absorption as well. The present work developed an Optical Coherence Tomography system capable of determine completely and uniquely the Mueller Matrix of a sample, in depth. In this way many measurements are needed to be done with different combinations of polarization states of the incident beam on the sample and the reference arm of the interferometer. After calibrating the system, a roll of adhesive tape was used as sample for two main reasons: presents birrefringent and has a periodic structure. Software also was developed to solve a matrix linear equations system. As a result a 4x4 matrix of images were calculated. Some of the features, as birefringence were easily indentified in some elements of this matrix, others, more subtle, can be founded in the literature. We also decomposed the matrix in three components (depolarizer, retarder and diattenuation) which allowed understand the sample as a linear combinations of three optical phenomena.

[13/05/10 - 17h00 - Room 5]
Defocusing Microscopy: Information from out of focus, Ulisses Moreira Silveira Andrade, , Oscar Nassif de Mesquita, Ubirajara Agero, *Departamento de Física - Universidade Federal de Minas Gerais*, Lucila Helena Deliesposte Cescato, *Instituto de Física Gleb Wataghin - UNICAMP* ■ Phase objects can be made visible by a slight defocus in a light microscope. This property is very useful to quantify fluctuations in cells and other biological samples that behave as phase objects in a microscope. The microscopy technique that quantifies these results, developed in the Physics of Biological Systems Laboratory, is called Defocusing Microscopy. The defocus creates a phase difference between the diffracted and non-diffracted light that generates a contrast in the image plane. In this work we show the validity of Defocusing Microscopy for larger defocus distances, in the order of $300\mu m$, and verify the theory limit defined by the paraxial approximation used in calculations. Diffraction gratings constructed in the Diffractive Optics Laboratory at UNICAMP were used as phase objects. The diffraction gratings have sinusoid profile with known period and amplitude. We show that, as predicted from the theory, diffraction gratings images present an oscillatory behavior with the correct frequency. We measure the diffraction grating profile using atomic force microscopy. We compare these results with amplitude measurements from the images in the focus position that maximizes the contrast. We obtain a very good agreement for the amplitude measurements. With these results we show Defocusing Microscopy limits of validity.

[13/05/10 - 17h15 - Room 5]
Determination of spectral responsivity of silicon trap photodetectors, Thiago Menegotto, Mauricio S. Lima, Hans Peter Grieneisen, Iakyra B. Couceiro, *INMETRO* ■ Measurement of optical power is of primary importance for both research and industrial laboratories. Up to now, the most accurate measurement of optical power is accomplished with cryogenic radiometer operating near 4 K. The principle of operation of the radiometer relies on the substitution of optical power by electrical power measurements. The light absorbing cavity of the cryogenic radiometer has a nearly flat spectral response from the ultraviolet up to the infrared region, but this equipment is not of practical use for everyday measurement. Therefore, good transfer standards for the visible range of spectrum are achieved with silicon photodiodes. Three of these photodiodes, when mounted in a trap configuration, exhibit a nearly a 100 % internal quantum efficiency and highly reduced dependence the state of polarization of the incident radiation.
We report on the work done at Inmetro to implement of a national standard for optical power measurements. A cryogenic radiometer is used to measure the optical power of a power-stabilized laser beam. This beam is made to impinge on a silicon trap detector and the photocurrent generated is measured by means of a calibrated current to voltage converter. Using this procedure, the spectral responsivity of the detector is measured for several wavelengths of HeNe laser and Ar ion laser. A simple model is applied to interpolate and extrapolate the spectral response over the whole visible spectral range. The obtained results show excellent agreement with detector previously calibrated at other national institutes of metrology.

[13/05/10 - 17h30 - Room 5]
Remote Characterization of Uranium 238, Niklaus Ursus Wetter, , Matheus Araujo Tunes, Marcello Magri

Amaral, Sonia Lucia Baldochi, Anderson Zanardi de Freitas, *Instituto de Pesquisas Energéticas e Nucleares* ■ The treatment of radioactive waste is a world wide ongoing research of paramount importance. Additionally, there are a series of isotopes, derivatives of radioactive waste, whose detection has not been solved so far by any existing technique. The Centro de Lasers e Aplicações do Instituto de Pesquisas Energéticas e Nucleares has the necessity to develop a methodology for remote characterization of radioactive wastes. Firstly, because present techniques require manual manipulation of the compounds and secondly, because optical trechniques as oposed to chemical techniques might be capable of analyzing some of the isotopes for which there either exist no chemical methods or only methods that are financially not viable. Our prospective studies, using existing laser techniques such as laser induced breakdown spectroscopy (LIBS) and traditional absorption spectroscopy (such as cavity ring-down spectroscopy), inquire on the possibility of remote sensing of fission elements. In our study we used a Nd:YAG laser, in Q-switched mode operating at 532 nm (green) with 12,5 MW of peak power and a sample of Uranium 238 inside a vacuum cell which was irrdiated. With a fiber optic coupled spectrometer the characteristic emission lines of Uranium 238 were captured and clearly identified. The preliminary results of this research will be presented.