エクストリームフォトニクスセミナー
Extreme Photonics Seminar

Date: April 26th(Mon), 2010, 10:00 ～ 12:00

Location: Cooperation Center, 5F Meeting Room, W524
(研究交流棟5階会議室 W524)

Title: Selective metallization on dielectric surfaces with femtosecond laser pulses and its application

Language: English

Speaker: **Dr. Jian Xu** (Laser Technology Lab., RIKEN)

In this talk, I will introduce the research topic about selective metallization on dielectric surfaces with femtosecond laser pulses and its application in SIOM. Firstly, a method for selective metallization on dielectric surfaces by combing the fs laser irradiation with successive electroless copper plating will be demonstrated. The geometrical shapes of the obtained copper microstructures can be controlled by adjusting the parameters of the fs laser direct writing and/or the chemical plating process. Furthermore, the mechanism of fs laser induced selective metallization will be discussed. The results show that silver atoms are produced on the surface of grooves formed by laser ablation, which serve as catalysis seeds for subsequent electroless copper plating. Secondly, based on above-mentioned method, embedded microelectrodes in dielectric materials and the electro-optic integration in crystal by using a fs laser will be demonstrated, showing a great potential for fabricating novel functional microdevices by a new technique named fs laser integration. Thirdly, a new surface enhanced Raman scattering substrate based on fs laser induced selective metallization will be described. The results show that, after fs laser irradiation and subsequent treatment of silver nitrate solution, the Raman signals from sample molecules can be well enhanced on laser-irradiated area of the glass chips, showing the potential for the development of novel integrated Raman bio-sensors and biochip systems. Last but not least, I will conclude my talk for demonstrating the importance and potential application of microelectric and plasmonic components fabricated by fs laser microprocessing.

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Title: Materials processing using laser plasma soft X-rays

Language: Japanese

Speaker: Prof. Tetsuya Makimura (Univ. Tsukuba)

Laser-produced plasma is a practical X-ray sources. We have investigated interactions of soft X-rays from the laser-produced plasma with solid state materials beyond the ablation thresholds. In the present talk, X-ray sources, focusing mirror, and materials processing will be presented.

Laser plasma soft X-rays were generated by irradiation of targets with pulsed lasers. Wide band X-rays in 10-500 eV are generated from Ta plasma, while narrow X-rays 92 eV (13.5 nm) and 113 eV (11 nm) from Sn plasma and Xe plasma, respectively. The X-ray emitting plasma was generated using either a Nd:YAG laser (532 ns, 10 ns, 500 mJ/pulse) or CO_2 laser (10.6 micrometers, 50 ns, 500 mJ/pulse). The Nd:YAG laser was used for irradiating materials at high power density, while the CO2 laser was used for generating narrow band soft X-rays.

The soft X-rays at high power density was achieved using a focusing mirror at a small grazing incident angle, that is designed to focus soft X-rays around 10 nm efficiently. For that purpose, we used an ellipsoidal mirror coated with an Au layer. Further, we have fabricated an Wolter mirror, which is an X-ray imaging mirror with grazing incident. It would be useful for practical use.

Applying the techniques, we have established nano- and micromachining of silica glass. It is remarkable that we have achieved high quality micromachining with a roughness Ra of 1 nm after etching by 470 nm in depth. Furthermore, nanostructures such as trenches with a width of 50 nm can be fabricated. Processing of polymethylmethacrylate (PMMA) and polydimethylsiloxane (PDMS) will be also presented.

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