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ABSTRACTS

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LINEAR AND NON-LINEAR OPTICAL PROPERTIES OF NEGATIVE Cu IONS IMPLANTED SILICA

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Quantum-size effects of electrons tend to become dominant in nanophase structures of a low dimension, and occasionally provide us with novel macro-properties. Nano-structures of 3-D electron confinement, *i.e.*, quantum dots (QDs), have recently attracted much attention because of their potential capability to develop novel optical properties. The quantum dots of metal colloids in dielectric substances exhibit nonlinear and fast optical response due to the surface plasmon resonance, which could be applied for opto-electronics. In this work, we have focused on the fabrication of Cu metal colloids which is well-defined and controllable and conducting the characterizations, taking advantage of beam technologies.

Negative Cu ions (Cu⁻) of 30 keV have been implanted in silica glass (OH⁻ < 200 ppm) at total doses from 3.0×10^{16} to 1.0×10^{17} ions/cm². Diameter of the disk silica substrates was about 15 mm, and the thickness was 0.5 mm. We applied metal Cu⁻ ions of a relatively low energy in order to form copper colloids embedded within a narrow layer, near the surface. Rather than positive ions implantation, which is more easily than negative ions method, we used negative ions in order to ameliorate the surface charging problem which always exists in the positive ions implantation of insulator. Cu⁻ implantation has been conducted at room temperature and post-implantation annealing was not used, since thermal diffusion affects the spatial controllability.

Optical absorption and reflection were measured in a photo energy range from 1.4 to 6.4 eV using a dual beam spectrometer with an unimplanted substrate as the reference. Reflection was measured with a reference Al mirror. Surface morphology of the implanted substrates was also examined by atomic-force microscopy (AFM) in the tapping mode. Cross-sectional electron microscopy, X-ray diffraction (XRD) and Rutherford backscattering spectroscopy (RBS) were used for the characterization of Cu colloids and distribution and concentration of the implants in substrates. The third order non-linear susceptibility, X(3) of the samples was measured by degenerate four wave mixing method. A frequency doubled Q-switched Nd:YAG laser provided 7 ns pulses at wavelength of 532 nm and frequency of 10 Hz.

Researches indicated that the metal colloids with Cu nanoparticles embedded in silica glass were formed by negative Cu ions implantation. A surface plasmon peak of Cu colloids at 2.2 eV was observed in optical absorption spectra, and can be roughly explained by the Mie theory. No evident defect-related absorption bands were found in all the samples. Although with the sputtering effects, AFM observations showed that the implanted area was smooth enough for optical measurement. The silica glass with Cu colloids showed a large non-linear susceptibility with X(3) in the order of 10^{-7} esu., when the bulk signal was normalized by the thickness of colloids. Also, the non-linear reflectivity of bulk material was found to be proportional to the square of laser pump intensity.

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ELEVATED TEMPERATURE PLASMA IMMERSION ION IMPLANTATION

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Nitrogen plasma immersion ion implantation (PIII) at elevated temperature enhances the surface properties of austenitic stainless steel materials. Using low voltage PIII, the surface properties of samples treated at 300°C, 400°C, and 450°C and for different implantation time are compared. GXRD results indicate that an expanded austenitic phase (γ_N) is formed in the modified layer at 300°C, but at 400°C, a uniform γ_N phase layer is obtained. The corrosion resistance of the treated samples is more superior to that of the unimplanted one. For the samples treated at 400°C and 450°C, the pin-on-disk wear data at a loading of 100 g do not show a wear track and the coefficient of friction is less than 0.3.

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