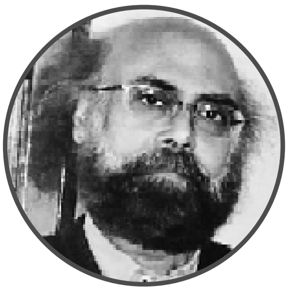
Purushottam Chakraborty, J Nanomedine Biotherapeutic Discov, Volume: 08
DOI: 10.4172/2155-983X-C1-002

Anti-resonant interferometric nonlinear spectroscopy (ARINS) study of metal-glass nanocomposites for photonic applications



Purushottam Chakraborty

Saha Institute of Nuclear Physics, India

Although electronics technologies have made great advances in device speed, optical devices can function in the time domain inaccessible to electronics. In the time domain less than 1ps, optical devices have no competition. Photonic or optical devices are designed to switch and process light signals without converting them to electronic form. The major advantages that these devices offer are speed and preservation of bandwidth. The switching is accomplished through changes in refractive index of the material that are proportional to the light intensity. The third-order optical susceptibility, $\chi^{(3)}$ known as the 'optical Kerr susceptibility', which is related to the non-linear portion of the total refractive index, is the non-linearity which provides this particular feature. Future opportunities in photonic switching and information processing will depend critically on the development of improved photonic materials with enhanced Kerr susceptibilities, as these materials are still in a relatively early stage of development. Optically isotropic materials, e.g. glasses that have inversion symmetry, inherently possess some third-order optical non-linearities. Although this is quite small for silica-glasses at λ=1.06 μm, the absorption coefficient is extremely low, thereby allowing all-optical switching between two waveguides, embedded in a silica fiber, simply by controlling the optical pulse intensity. Different glass systems are under investigation to increase their non-linearity by introducing a variety of modifiers into the glass-network. The incorporation of semiconductor micro-crystallites enhances the third-order optical response. Metal colloids or nanoclusters, embedded in glasses, have also been found to introduce desired third-order optical non-linearities in the composite at wavelengths very close to that of the characteristic 'surface-plasmon resonance' of the metal clusters. Ion implantation is found to be an attractive method for inducing colloid formation at a high local concentration unattainable by melt-glass fabrication process and for confining the non-linearities to specific patterned regions in a variety of host matrices. The author's recent works on metal-ion implanted colloid generation in bulk silica glasses have shown that these nanocluster–glass composites under favorable circumstances have significant enhancement of $\chi^{(3)}$ with picosecond to femtosecond temporal responses. These metal nanocluster-glass composites have been imaged using transmission electron microscopy and confirmed using linear optical absorption and Rutherford backscattering spectrometry (RBS). Nonlinear refractive index and two-photon absorption of these nanocomposites have been observed using Z-scan, degenerate four-wave mixing and anti-resonant interferometric nonlinear spectroscopy (*ARINS*) in the close proximity of surface plasmon resonance (*SPR*) wavelength of these metal nanoclusters. Both sign and value of the nonlinear parameters are determined and the third-order optical susceptibility of the composites has been found to be significant. Such metal nanocomposites in glasses having appreciable $\chi^{(3)}$ with temporal responses in picosecond to femtosecond time domain have great relevance to futuristic switching materials in nanophotonics.

Biography

Purushottam Chakraborty Considered India's one of the most prominent figures in the field of Spectrometry, he is one of the world's leading experts in SIMS. He has published more than 150 scientific papers impacting the discipline through vast knowledge. He has given lectures over 130 countries including Invited talks and Chaired Sessions across the globe. Honored with numerous awards, including the "Most eminent Mass Spectrometrist of India" in 2003 is most significant one among many.

purushottam.chakraborty@gmail.com