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[Abstract Guideline (Leave two lines for presentation number)]

Ion Beam Synthesized Metallic Nanoparticles for Photonic Applications

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Metallic nanoparticles embedded in dielectrics lead to localized surface plasmon resonance (LSPR) effect under light excitation. Such effect may enhance the optical nonlinearities of the bulks significantly. Under some conditions, the dielectrics (including glass and crystals) with embedded metallic nanoparticles exhibit saturable absorption properties, which could be utilized as efficient saturable absorbers to realize pulsed lasers through Q-switching or mode-locking configurations. Ion implantation is one of the major techniques for materials modification. Energetic ions are implanted into the substrates, inducing alternations of properties of diverse materials. In photonics, ion implantation has been widely utilized to form optical waveguides by changing the refractive indices of the dielectrics, and to fabricate thin-film wafers of functional materials. It has also been used to synthesize nanoparticles that are embedded in the implanted substrates, leading to significant property modification of these bulks. In recent years, we construct metallic (e.g., Au or Ag) nanoparticle embedded dielectric systems (e.g., fused silica, BK7 glass, Nd:YAG, $LiNbO_3$ crystals etc), which are fabricated by ion implantation and/or subsequent annealing, a well-developed chip-technology. The strong optical absorption in visible light band has been observed due to the localized surface plasmon resonance. The Z-scan investigation shows that those dielectric embedded with metallic nanoparticles possess ultrafast saturable absorption properties at both visible and near infrared wavelength of 1μm. With this feature we apply the nanoparticles embedded crystal wafers as saturable absorbers into Pr or Nd doped laser platform. We have obtained stable laser pulses at 639 and 1064 nm based on an efficient passive Q-switching or mode-locking process. In addition, we also find that the dielectric with embedded nanoparticles can be combined with 2D materials, serving as unique plasmon-2D hybrid platforms for optoelectronic devices, such as photodetectors. The performance of the new developed 2D photodetectors are significantly improved by the enhanced light-matter interactions in 2D materials. Our work opens the way to develop intriguing devices in photonics and optoelectronics by using dielectrics with embedded metallic nanoparticles.

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