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Development of Nanostructured Light-Absorbers for Ultrasound Generation by Using a Solution-Based Process

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Under nanosecond-pulsed laser irradiation, light-absorbing thin films have been used for photoacoustic transmitters for ultrasound generation. Especially, nanostructured absorbers are attractive due to high optical absorption and efficient thermoacoustic energy conversion: for example, 2-dimensional (2-D) gold nanostructure array, synthetic gold nanoparticles, carbon nanotubes (CNTs), and reduced graphene oxides. Among them, CNT has been used to fabricate a composite film with polydimethylsiloxane (PDMS) that exhibits excellent photoacoustic conversion performance for high-frequency, high-amplitude ultrasound generation. Previously, CNT-PDMS nanocomposite films were made by using a high-temperature chemical vapor deposition (HTCVD) process for CNT growth. However, this approach is not suitable to fabricate large-area CNT films (>several cm2). This is because a chamber dimension of HTCVD is limited and also the process often causes nonuniform CNT growth when the film area increases. As an alternative approach, a solution-based process can be used to overcome these issues. We develop PDMS composite transmitters, based on the solution process, using several nanostructured light-absorbers such as CNTs, nanoink powders, and imprinted regular arrays of gold nanostructure. We compare fabrication processes of each composite transmitters and photoacoustic output performance.

Keywords: Nanostructured absorbers, photoacoustic transmitters, CNT-PDMS composite