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Size-Controlled Synthesis of Bismuth Nanoparticles by Temperature Assisted Pulsed Laser Deposition

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Abstract : It has been observed that when the size of metals such as, Au, Zn, Ag, Cu, Te, and metal oxides is reduced to several nano-meters, it starts to show further interesting properties. These new properties boost the use of nano-structures to produce attractive functional materials or used as promising building blocks in electronic devices. Present work describes the synthesis of bismuth (Bi) nanoparticles (NP's) having uniform morphology, high crystallinity, and single phase purity by the temperature assisted pulsed laser deposition (TAPLD). Pulsed Laser deposition (PLD) technique is one of the promising methods to synthesize nano-structures. It can provide the stable nucleation sites in orders of magnitudes higher than for MBE and sputtering deposition. The desired size of purely metallic Bi NP's of can be easily controlled by adjusting the temperature of the substrate varying from 1000 C to 250 0C. When the temperatures of the substrate raised step wise the average size of Bi NP's appeared to be increased by maintaining the uniform distribution of NP's on the Si surfaces. The diameter range of NP's is ~33-84 nm shows size distribution constrained in the limited range. The EDS results show that the 0D Bi NP's synthesized at high temperature (250 0C) at a high vacuum still remained in a metallic phase. Moreover, XRD, TEM and SAED results showed that these Bi NP's are hexagonal in crystalline in a space group R -3 m and no traces of bismuth oxide, confirming that Bi NP's synthesized at wide range of temperatures persisted of the pure Bi-metallic phase.

Keywords : metal nano particles, bismuth, pulsed laser deposition (PLD), nano particles, temperature assisted growth
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