Nanoparticles during additive manufacturing

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Abstract

Additive manufacturing is particular interesting to fabricate structures that are not accessible by conventional machining processes [1-3] and therefore an emerging field. Beside the unique geometries that can be fabricated attaching gold nanoparticles to the powder materials results in enhanced sintering parameters and sintering thresholds decrease in case of off-resonant [4] and resonant laser sintering [5]. More remarkable, the fabrication of dispersed micro/nano ultra-structures is observed after sintering of the compounded gold-nanoparticle/zinc oxide-microparticle hybrid material. By cutting a thin micro lamella from the sintered and un-sintered ZnO@Au particles we could show that the gold nanoparticles are embedded in the ultra-structure after laser sintering. Therefore laser processing of nanoparticle/microparticle composition gives access to interesting hybrid materials. Observations for the process window to cause sintering in dependence of gold nanoparticle amount on zinc oxide led to the conclusion that off-resonant near field enhancement is responsible for amplified photon conversion. This demonstrates that during additive manufacturing nanoparticle materials can be embedded into the sintered matrix of microparticles.

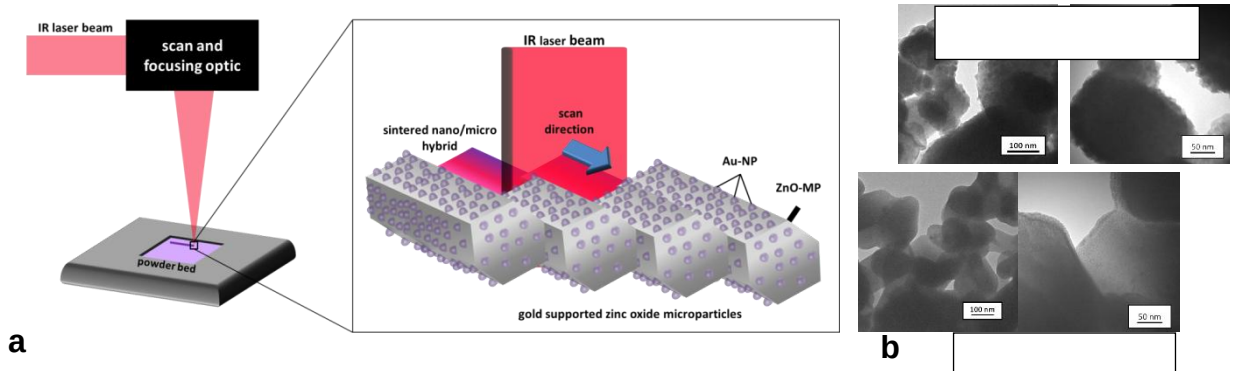

Figure (a) Schematic illustration of the laser process to fabricate sintered structures. (b) Transmission electron pictures taken from the un-sintered (top) and sintered (bottom) microparticles with 5 wt% of surface adsorbed gold nanoparticles. After laser sintering a smooth surface with sintered microparticles can be observed [4].

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