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Three-dimensional flexible ceramics based on interconnected network of highly porous pure and metal alloyed ZnO tetrapods

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Abstract

Flexible and porous three-dimensional (3-D) ceramics made from inorganic metal oxide nano- and micro-structures are going to be material candidates for future nanotechnologies. In the present work an attempt in this direction is demonstrated, where 3-D interconnected networks based on pure and metal (M)-alloyed ZnO nano- and micro-scale tetrapods (ZnO-T) have been synthesized via a versatile flame transport synthesis green route. The morphological evolutions of such networks have been investigated by scanning electron microscopy. Growth behavior of 3-D networks under different experimental conditions has been discussed. These ZnO-T networks were alloyed with different metals (Al, Cu, Sn, etc.) and accordingly characterized in detail for various properties. X-ray diffraction studies confirmed the crystal structure of such 3-D ZnO interconnected networks. The porosity of these interconnected 3D networks was tuned by controlling the initial tetrapods concentrations and M-alloying level, thus metal doped highly porous networks (up to 98%) have been synthesized. Electrical conductivity and mechanical strength of these networks were measured, as well as the correlation between porosity and alloying has been established. The properties of the pure and M-alloyed ZnO-T based flexible 3-D ceramic networks could be suitable for diverse utilizations in synthesizing new varieties of nano- and micro-scale 3-D materials and multifunctional practical applications.