Morphological Evolution of Metal Nanoparticles in Metal-Carbon Nanotube Composites

JIANXIN ZHONG, G. MALCOLM STOCKS, Oak Ridge National Laboratory — Metal nanoparticle-carbon nanotube composites are new emerging nanomaterials with a variety of potential technological applications such as fuel cells, sensors, and nanocatalysts. Currently, fabrication of these nanocomposite materials proceeds via trial and error due to the lack of fundamental understanding of their growth mechanisms. We propose a model to elucidate the morphological evolution of metal nanoparticles grown on surfaces of carbon nanotubes. The model is based on a novel concept, namely, bending-strain-induced self-organization of nanoparticles on curved surfaces. In the framework of continuum theory of elasticity, a criterion is derived to predict the size and shape of metal nanoparticles. Applications of the criterion to different metals show good agreement with experimental results. Our model is expected to be very fundamental. It has the potential to have important applications to understanding and controlling nanomaterials growth on any substrates with curved surfaces.

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