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ID-5-P-2537 Gold Nanorods with Polymers for drug delivery : Imaging the Soft/Hard Materials Interface

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The interface between soft and hard materials is currently underexplored territory that is critical to underrated structure relationships with the hard/soft materials interface domain. You need high resolution of the hard material, but good contrast (and resolution) of the corresponding soft materials. Low-voltage High-Resolution Electron Microscopy (LVHREM) has several advantages: increased cross-sections for inelastic and elastic scattering and hence higher contrast efficiency from each atom and reduced radiation knock-on damage to samples insensitive to other damage mechanisms, which includes most metals, semiconductors and other solid state materials. We have also conducted many experiments imaging with very low voltage SEM.

As an example: Gold nanorods can be used as photothermal converters, permitting near-infrared (NIR) light to be transmitted deep into tissues without causing damage (Fig. 1). The temperature-sensitive material poly(N-isopropylacrylamide) (pNIPAm) collapses when heated beyond 32 ºC, and has been used in drug delivery systems. Composites between these two disparate materials can be triggered with NIR light and open new avenues for triggerable drug delivery systems. Toward this end, we synthesized pNIPAm nanogel particles and conjugated them to polyelectrolyte-coated gold nanorods via electrostatic interactions. LVHRTEM enables imaging of both the polymer and gold components of these composite structures, and elucidates their interface (Fig. 2).

Although the TEM samples must be significantly thinner for low keV observation, the improvement in contrast for inorganic materials, biological samples and especially nano-biological samples in low-voltage TEM while retaining atomic resolution cannot be understated. Damage mechanisms for biological samples are complicated and very structure dependent.

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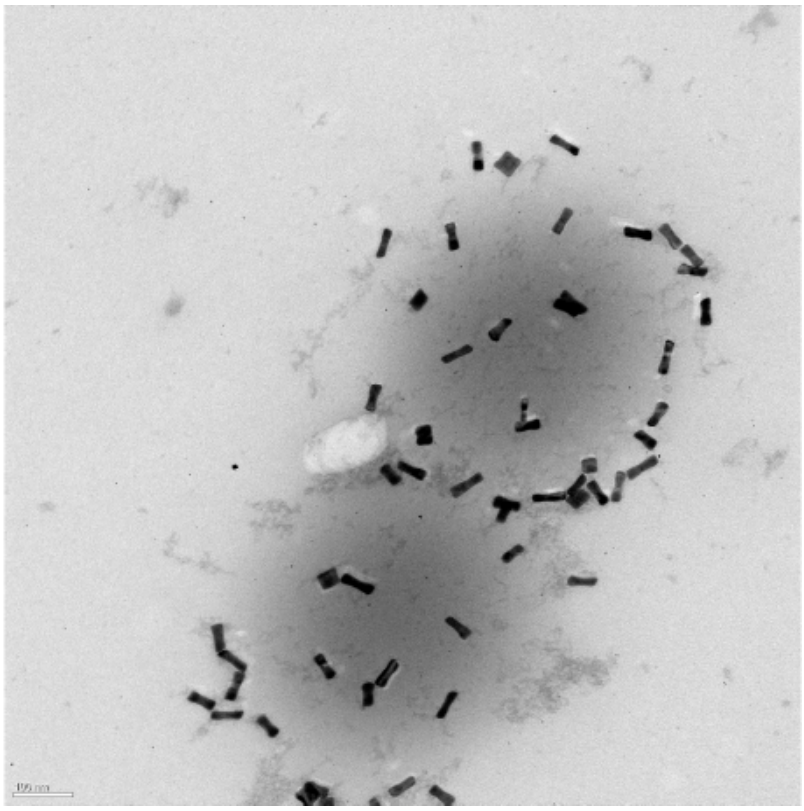

Fig. 1: Low Magnification TEM image of polymer spheres covered with gold nanorods

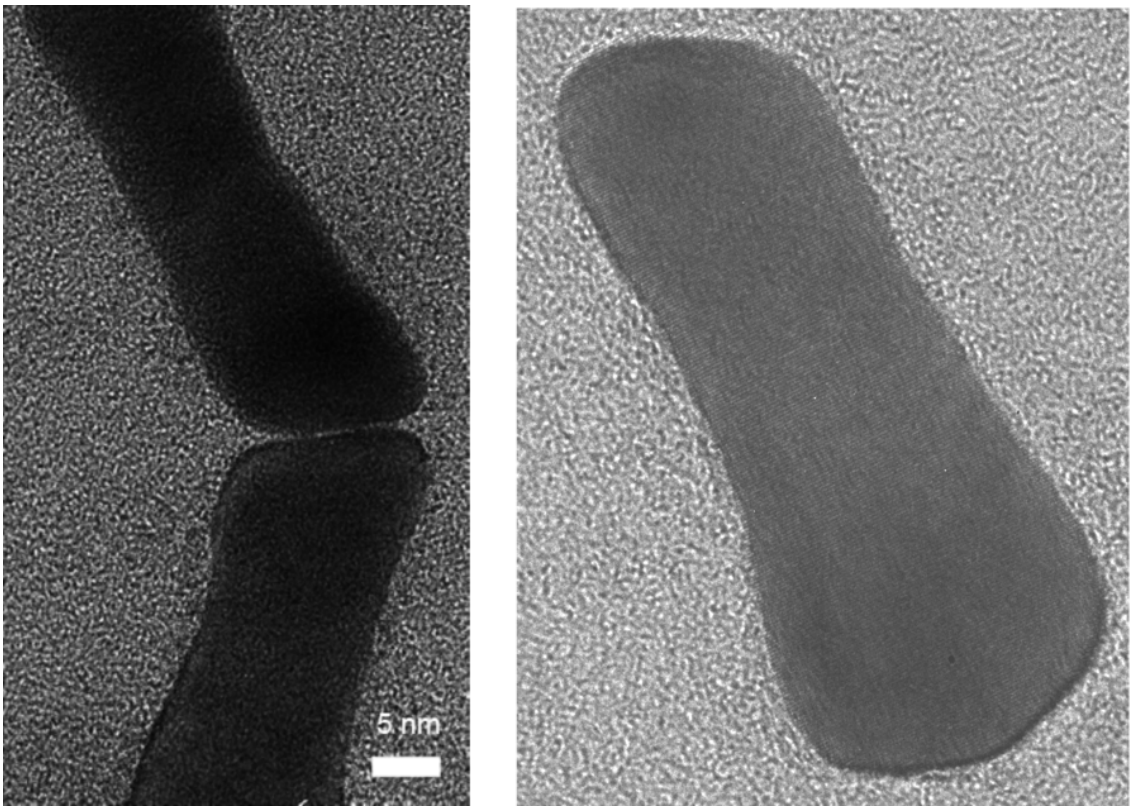

Fig. 2: Imaging the materials interface between gold nanorods and the polymer thermoplastic junction.