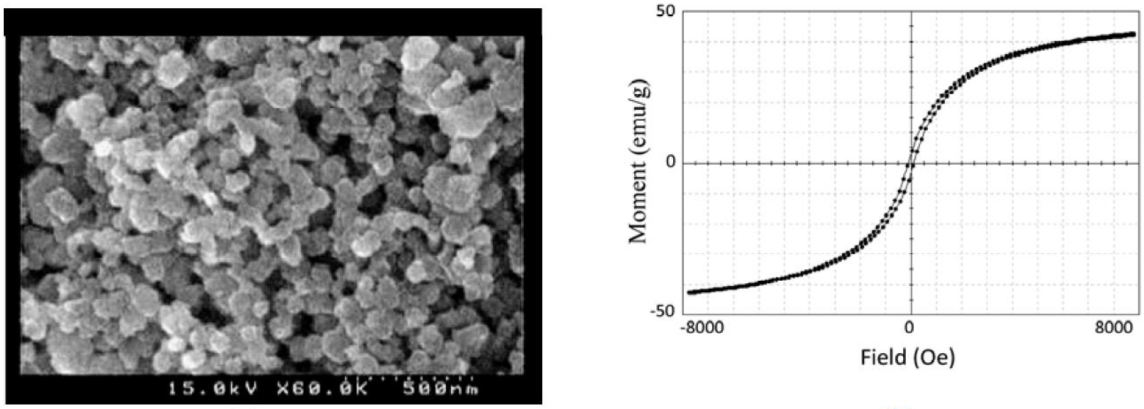
The **Axelbaum Lab** (EECE) involves many areas of nanotechnology that are related to nanomedicine. They study combustion-generated nanoaerosols. The materials they study can be from the combustion of fossil fuels for power generation, leading to the production of combustion byproducts such as soot or heavy metals, or from the controlled synthesis of nanomaterials for application. Both types of materials are important for nanotoxicology because the nanomaterials generated from combustion, whether as byproducts or for the nanomaterials themselves, can have harmful health effects. In addition, they synthesize nanomaterials that can be used in nanomedicine, specifically for targeted drug delivery. An example is niobium-encapsulated superparamagnetic iron. An SEM of the particles is shown in Fig. 1a and magnetization curve, shown in Fig. 1b shows the low coercivity of these materials, which demonstrates their superparamagnetic behavior. These materials, in addition to being superparamagnetic, have a very high saturation magnetization and are radio-opaque and biocompatible, all essential requirements for magnetically guided drug delivery.

They also have developed a novel approach to producing non-oxides nanomaterials, and this technology has recently been licensed to a major corporation (see below). Despite their significant value, nano-metals and non-oxide ceramics are difficult to synthesize and stabilize. Figure 2 shows an example of nano-titanium that has been encapsulated in sodium chloride. Their approach allows the materials to be safely produced but there are many toxicological questions that must be addressed with these materials as the reactivity of nanomaterials, particularly metals and non-oxide ceramics can be drastically different from their bulk counterparts. A third area of research is that of carbon nanotube synthesis. Carbon nanotubes have many unique and desirable properties but their long aspect ratio (Fig. 3) is suspected of asbestos-like behavior. Due to the variability of synthesis methods and the subsequent influence on the size, shape, chirality and impurities, understanding the fundamental toxicological concerns of carbon nanotubes is an important area of research. A critical parameter thought to influence their asbestos-like behavior is the nanotube length and we are able to produce single-walled carbon nanotubes of varying length. Thus, controlled nanotoxicology studies are possible. Also, the Lab has been engaged in the commercialization of nanotechnology. Their laboratory-scale process for producing nanometals was scaled up by a startup company that RLA founded. Cabot Corporation subsequently acquired the technology, and is commercializing it. The technology transfer has led to close ties between the University and Cabot.

The Axelbaum Lab: http://wulacer.com/



(a) (b)

Figure 1 Niobium-encapsulated superparamagnetic iron synthesized for targeted drug delivery: a) SEM of powder and b) Magnetization curve showing a small coercivity, indicating superparamagnetic behavior.

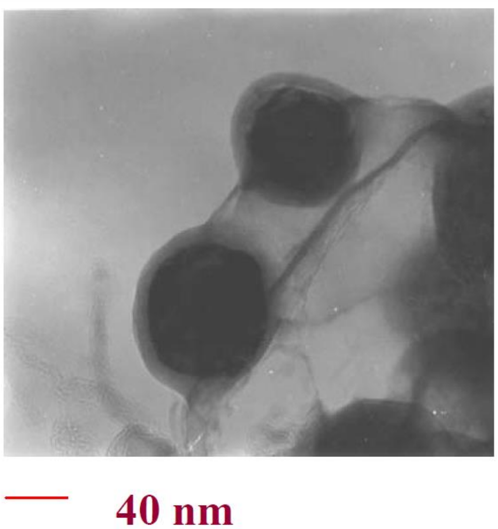


Figure 2. TEM image of salt-encapsulated titanium nanoparticles. The titanium nanoparticles are dark and the salt encapsulate is the light material covering the titanium particles.

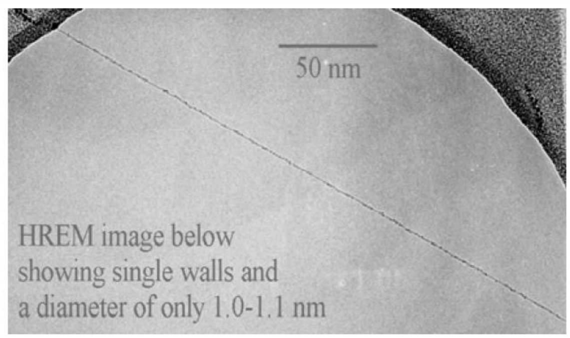


Figure 3. TEM image of a single-walled carbon nanotube showing the long aspect ratio of the tube and the potential for asbestos-like behavior.