

Enabling automated characterization of 1D rigid nano-objects

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Introduction

Sizes of nano-objects are strongly correlated with macro-scale properties. Monitoring and control of these dimensions can lead to development of broadly applicable quality engineering tools for nanomanufacturing. But this requires that methods for obtaining accurate estimates of nano-object dimensions, in quick time, be available. This project is a step in realizing such methods.

Aim of the project

- Develop Algorithms for extracting nanorod projections from an electron micrograph

Methods

- Task is of segmenting nanorod projections in electron micrograph
- Primary challenge is overlapping of nanorods. To partially overcome this we only extract 'heads' of nanorods, which have fewer overlap. They will all be extended to the fixed substrate and projection lengths can be obtained.
- Segmenting heads is challenging due to partial overlap and low signal-to-noise ratio.
- Segmentation approach: (1) obtain candidate edges from Canny operator, (2) regularize side edge segments by robust line fitting, (3) use fitted models to join side edge segments and top edge segments.

Summary and Future Work

- We have developed an approach for automated extraction of 1D rigid nano-object projections from an electron micrograph
- *Future work:* methods for estimating nanorod lengths by fusing projection estimates from multiple electron micrographs obtained at different microscope tilt angles

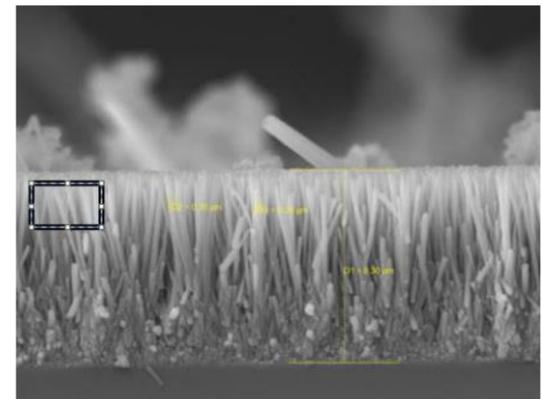
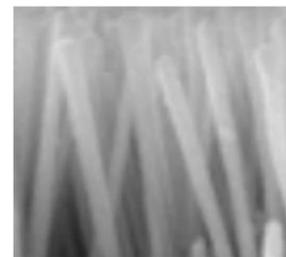
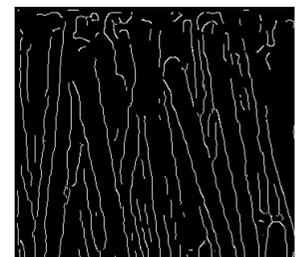


Fig. 1 Scanning Electron Microscopy image of AZO nanorod array



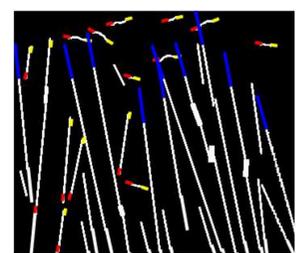
(a) Inset from electron micrograph in Fig. 1



(b) Edges detected by Canny operator in (a)



(c) Regularized edges from (b)



(d) Shape completion by dilating regularized edges in (c)

Fig. 2 Segmentation of electron micrograph in Fig. 1

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