

# Preparation of Nanoplatelets Using Vacuum Roll Coating

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500 nm

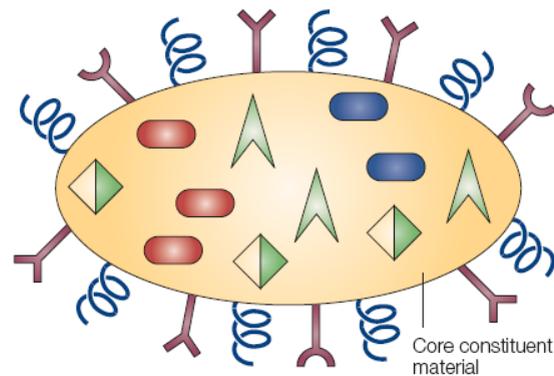
**Funded by: National Institutes of Health & SwRI Internal R&D Program**



# Introduction: Nanoparticles

Promising application: Multifunctional nanoparticles as “nanovectors” for drug delivery

## Conventional:



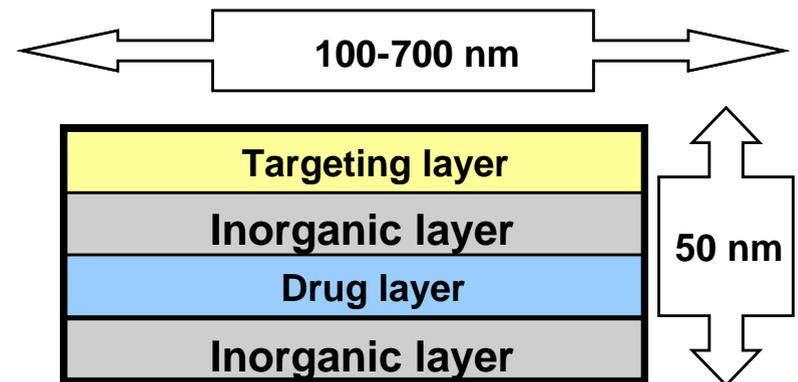
Therapeutic or imaging payload	Biological surface modifier
Drug A	PEG
Drug B	Targeting moieties
Contrast enhancer	
Permeation enhancer	

Ferrari, M. *Nature Rev./Cancer* 2005, 5, 161.

### “Bottom up self-assembly process”

- Sol-gel processing
- Wet chemical precipitation
- Reverse micelles

## Alternative:



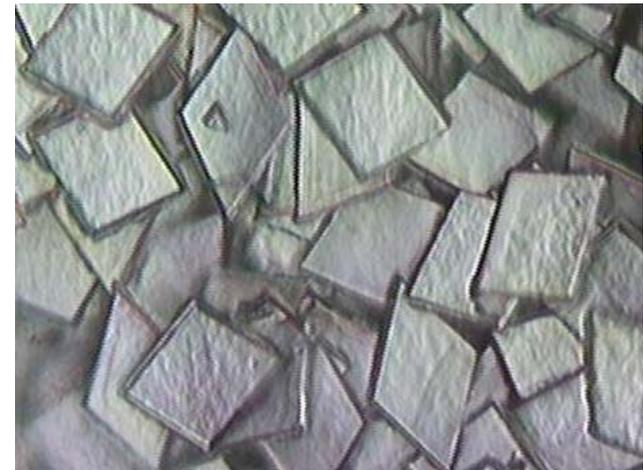
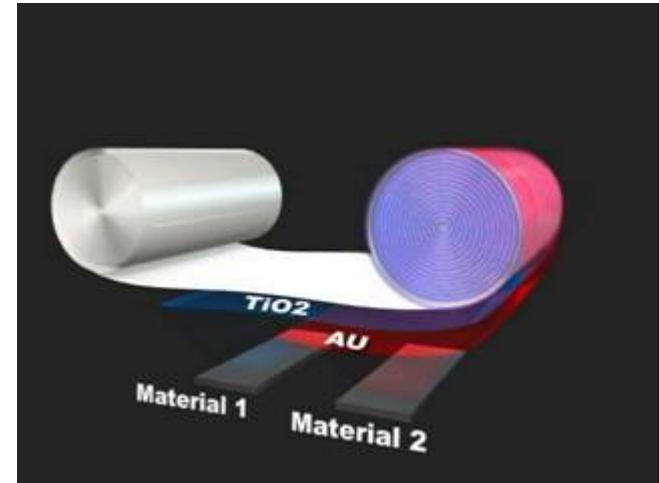
### “Top-down process”

- Planar substrate
- Layer-by-Layer (LbL) with roll-to-roll process
- Control of morphology
- Manufacturability



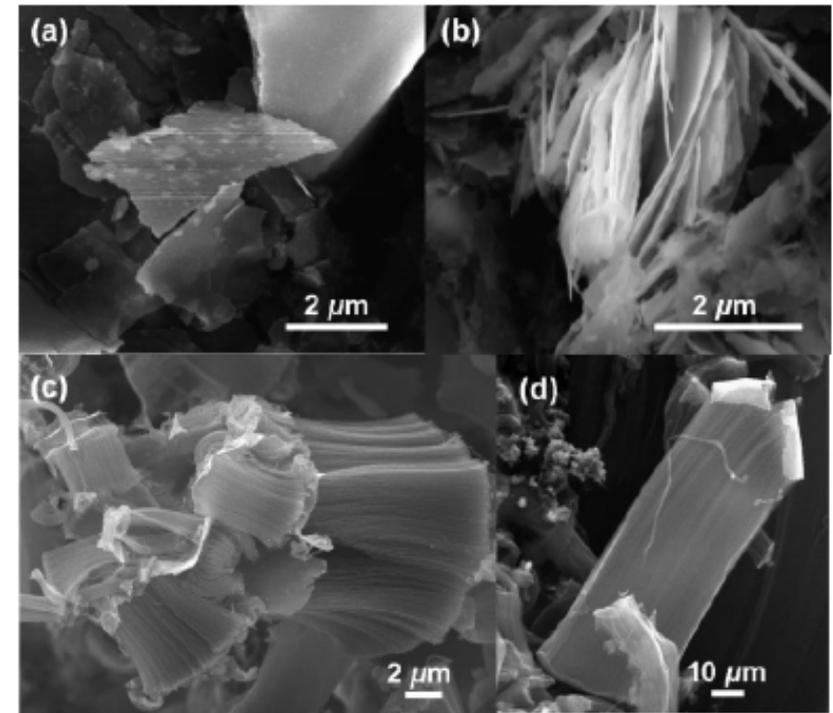
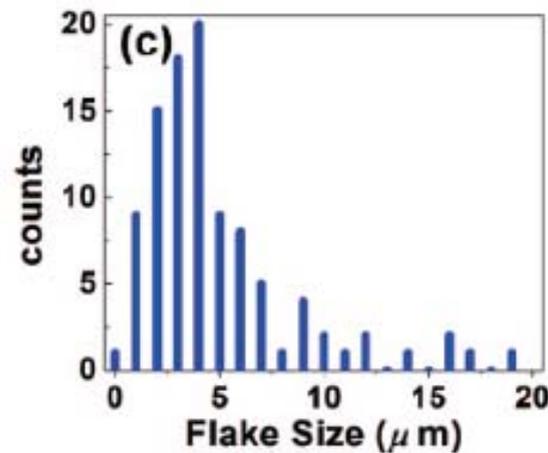
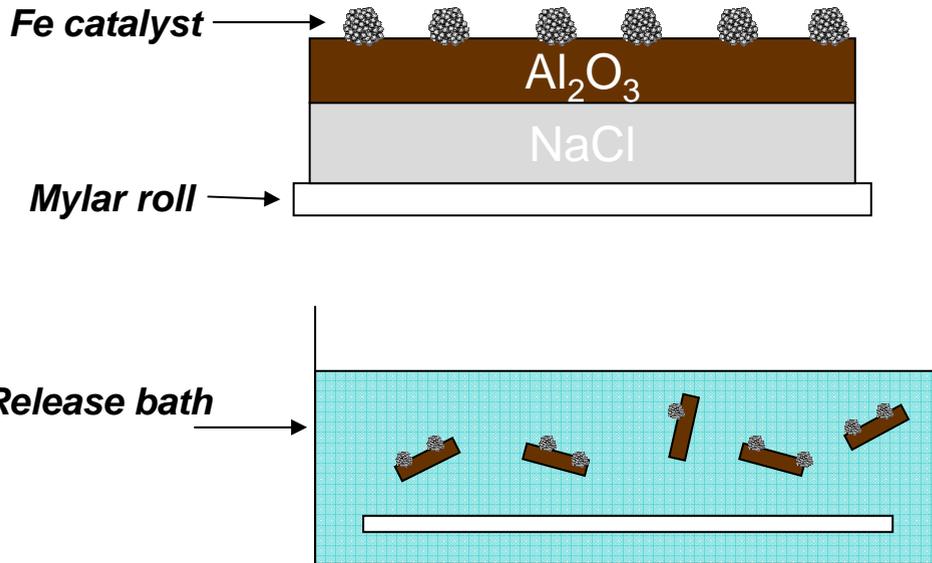
# Introduction: Vacuum Roll Coating

- Roll-to-roll vacuum coating on moving plastic substrates is an **industrially mature technology**.
- Multilayer films deposited on release layers can be removed from the substrate to form **free-standing planar platelets** with very high aspect ratios.





# Introduction: Platelets for CNT Synthesis

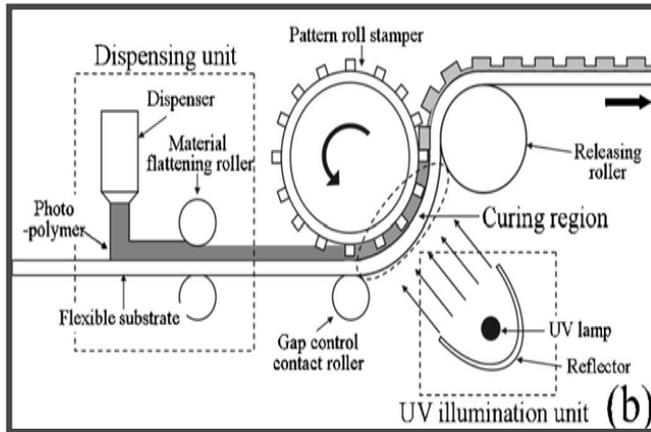


Pint, C. et. al, *Nano Letters*, 2008, 8(7), 1879.

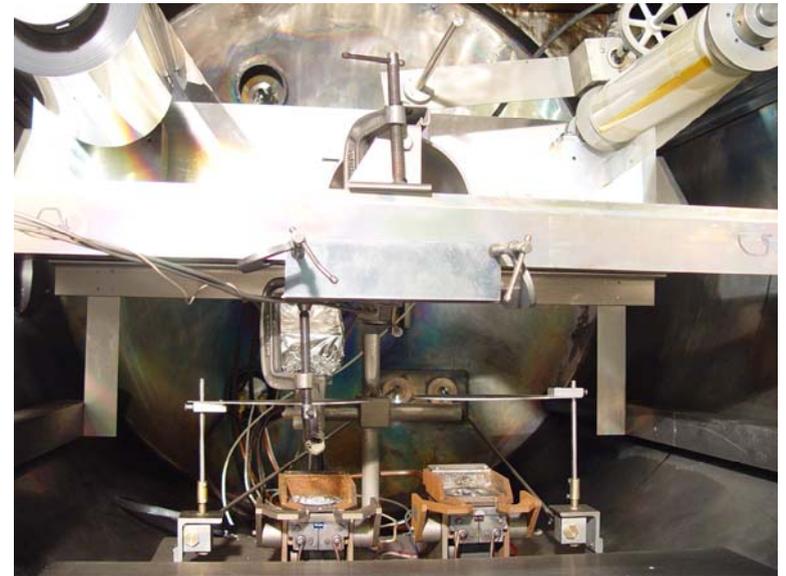


# Summary of nanoplatelet manufacturing process

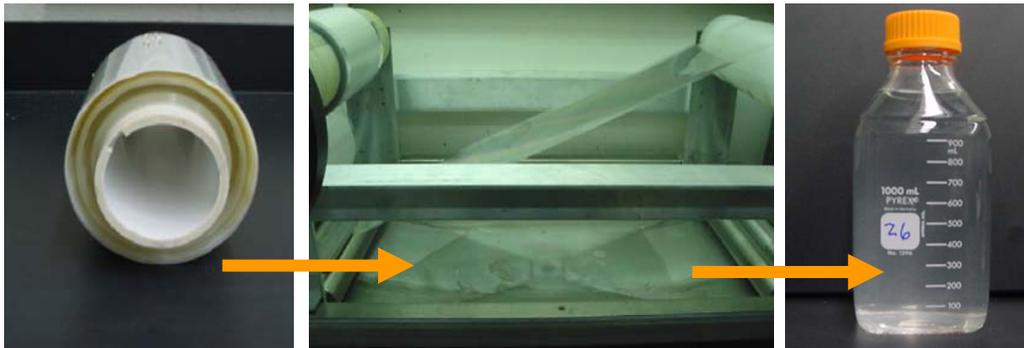
## Step 1: Nanopatterning



## Step 2: Layer by Layer Coating

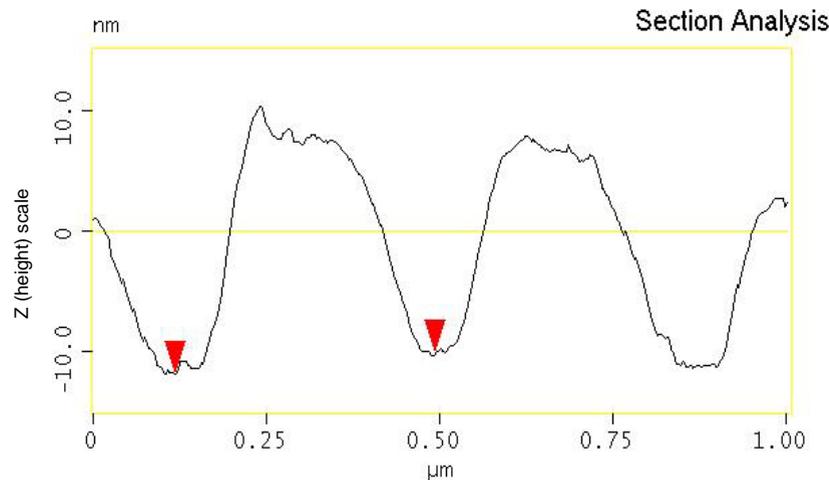
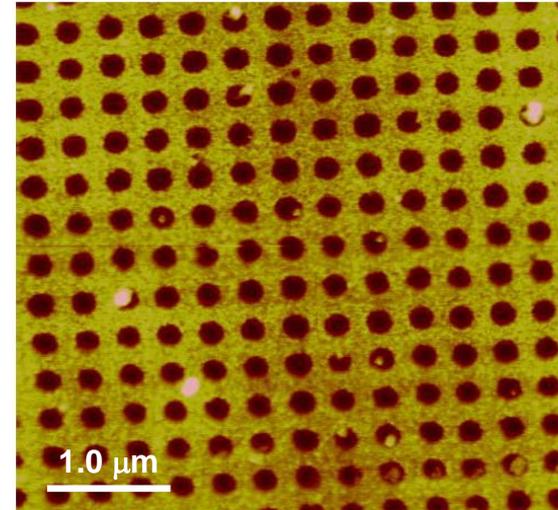
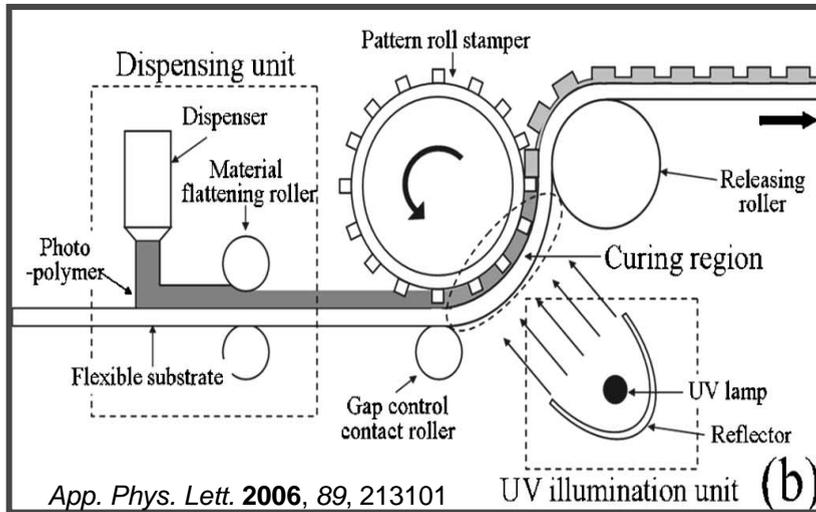


## Step 3: Nanofragmentation





# Step 1: Nanopatterning

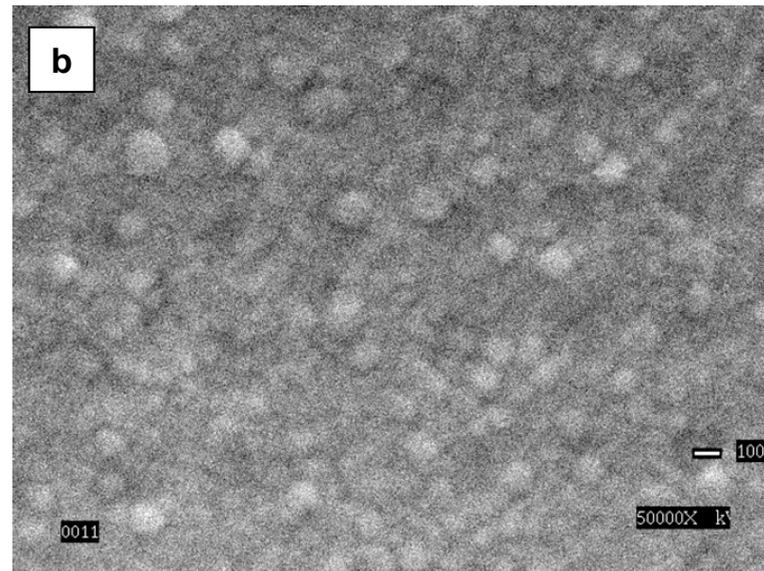
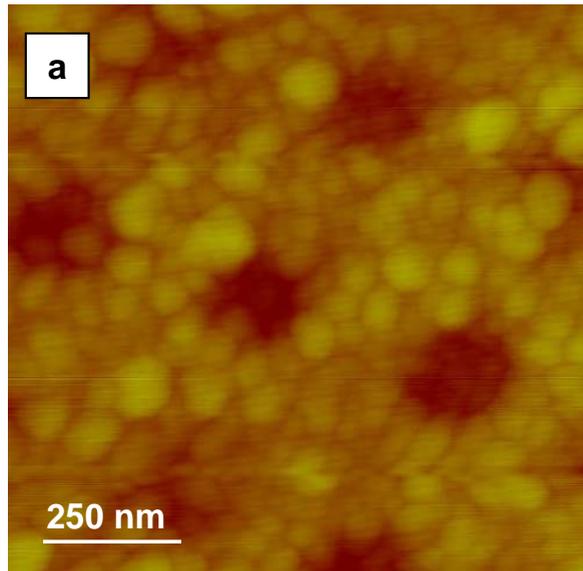
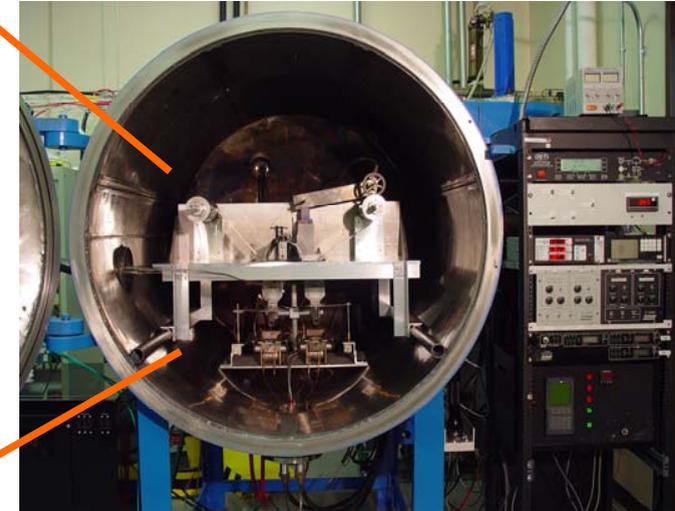
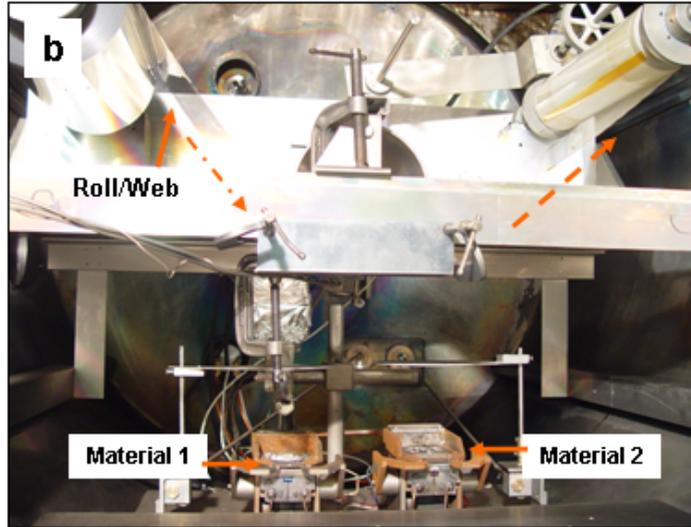
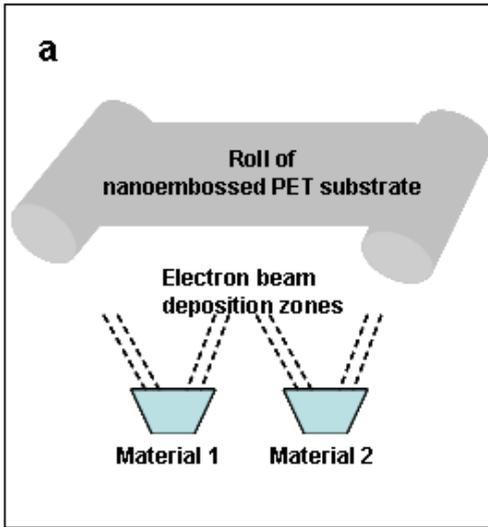


The pattern was replicated onto 10,000 linear feet that was 6" wide.

*Wavefront Technologies, Inc.*

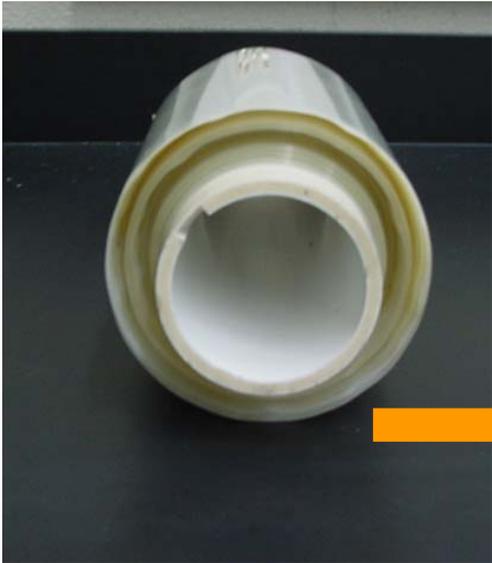


# Step 2: Layer by layer coating

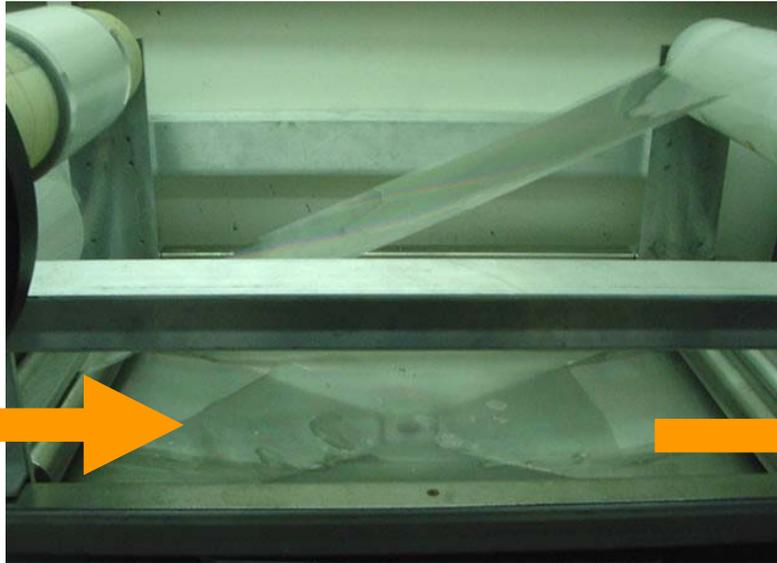




## Step 3: Nanofragmentation



500 ft roll of nanopatterned PET with deposited films



Roll handling mechanism and solvent pan used to pass roll through aqueous solution

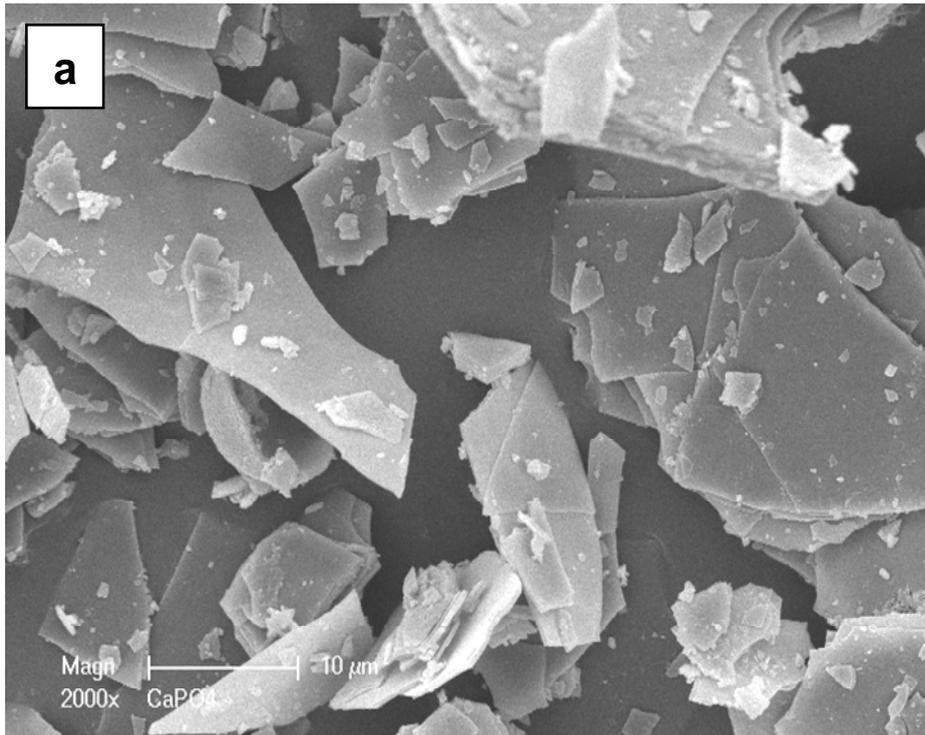


The resulting solution of nanoplatelets.

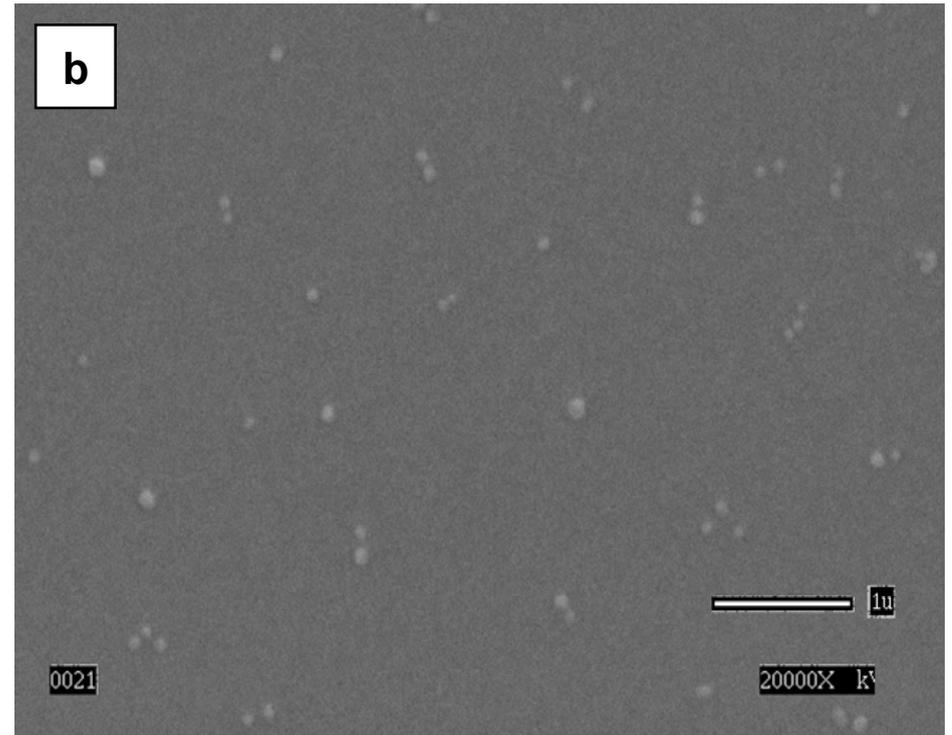


# Characterization: Particle size distribution

Flat (no pattern) substrate



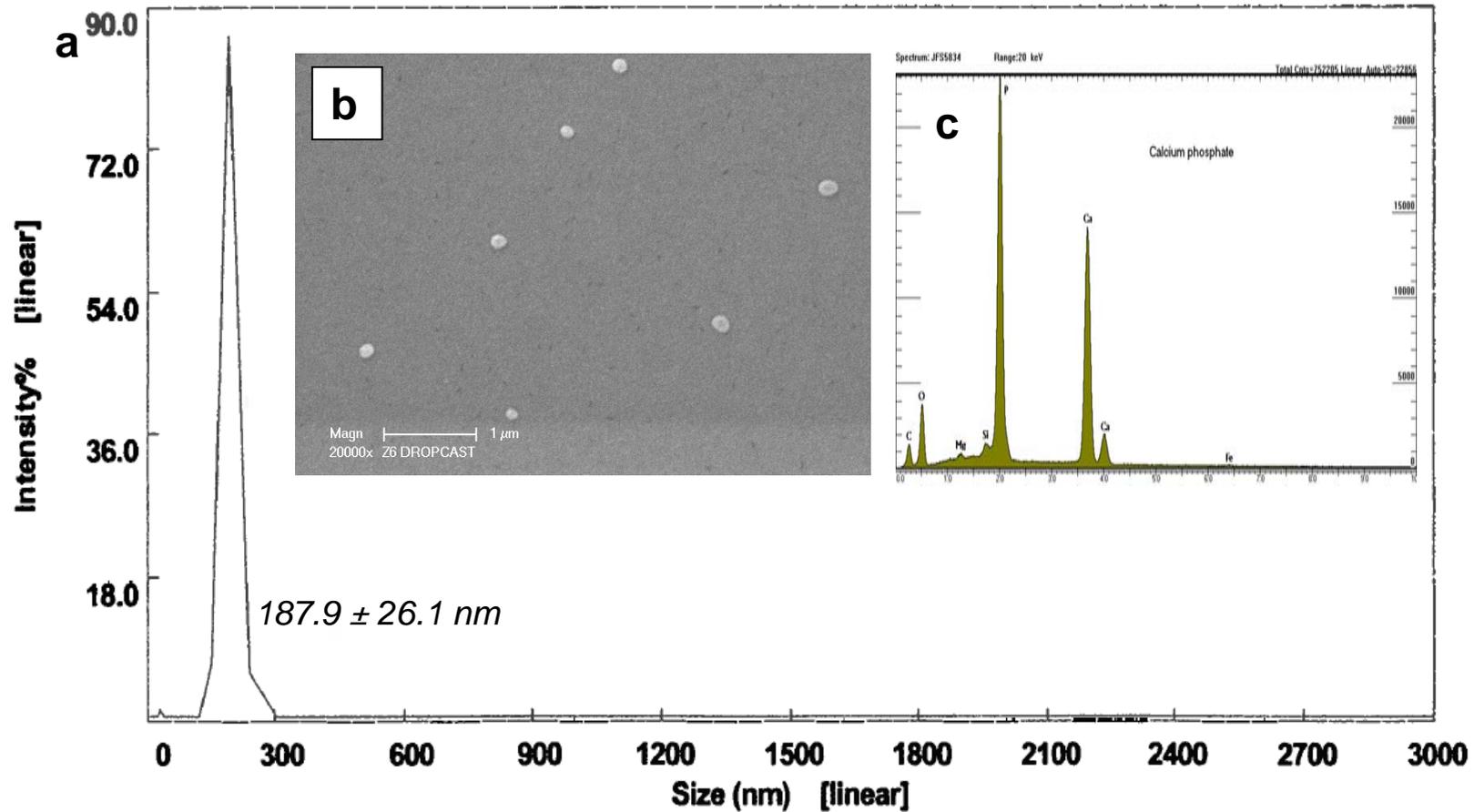
Nanopatterned substrate



**Use of the nanopatterned substrate results in significantly narrowing the particle size distribution.**



# Characterization: Calcium phosphate





# Summary

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- **Nanoplatelets have been successfully prepared by a top-down vacuum evaporation on a nanoembossed, moveable substrate.**
- **This method of manufacture has advantages of controlling the morphology (size and shape) and preparing appreciable quantities.**
- **Preparation on planar substrate is amenable to repetitive coatings in a layer by layer (LbL) method by functional agents using a roll-to-roll process.**
- **Further information can be found at**
  - [www.swri.org](http://www.swri.org) & [www.surfaceengineering.swri.org](http://www.surfaceengineering.swri.org)

**or**

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