Dislocation-Driven Nanomaterials Growth: Nanowire Trees, Nanotubes, and Their Potential Applications in Solar Energy Conversion

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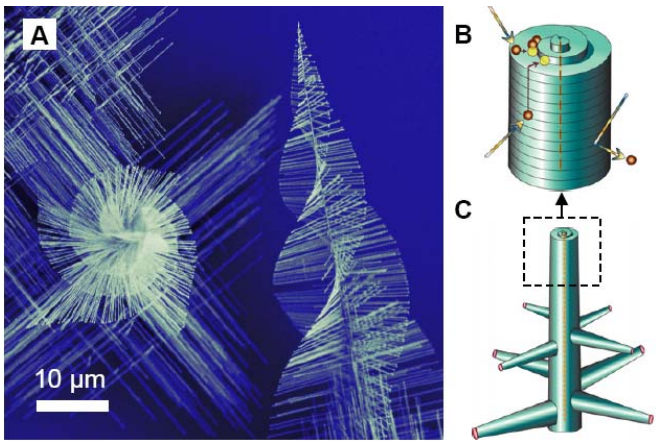
I will discuss a nanowire formation mechanism that is different from the well-known vapor-liquid-solid (VLS) growth. Axial screw dislocations provide the self-perpetuating steps to enable 1-dimensional (1D) crystal growth, unlike previously understood mechanisms that require metal catalysts. This mechanism was initially found in hierarchical nanostructures of lead sulfide (PbS) nanowires with helically rotating branches resembling "pine trees". I will further explain how dislocations result in the spontaneous formation of nanotubes and use classical crystal growth theory to conclusively prove that the anisotropic growth of these 1D materials is driven by dislocations. Dislocation-driven growth should be general to many materials in both the vapor phase and solution growth and is underappreciated in modern nanomaterial literature. Our discoveries will create a new dimension in the rational design and synthesis of nanomaterials. It could enable the applications of novel complex hierarchical nanostructures in solar energy harvesting and our understanding will allow the low cost synthesis of nanowire materials for large scale energy applications.



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