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TITLE:
Efficient and systematic exploration of catalysts for nanomaterials synthesis

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ABSTRACT BODY:
The physical properties of nanomaterials in general, and of carbon nanotubes in particular, are known to depend strongly on the chemical composition of the catalyst particles from which they are grown. It is therefore important to develop means to systematically investigate this correlation, both in order to gain fundamental physical insights into catalytic mechanisms and in order to optimize the properties of nanomaterials. We have developed a pulsed-laser deposition (PLD) approach to form orthogonally overlapping metallic gradients ('wedge'-shaped thickness profiles) as catalysts for the chemical vapor deposition of vertically-aligned carbon nanotubes from acetylene. In this approach, the effects of catalyst composition and layer thickness are studied simultaneously on a single substrate, allowing us to visualize broad trends efficiently and reliably. The sub-monolayer deposition rate control in this PLD approach further enables us to 'zoom in' very accurately to specific ranges of parameters. Here we describe the technical challenges of the approach and discuss the broad applicability to a variety of catalytic-growth studies. Results showing the discovery of a particularly efficient catalyst in the Fe-Mo system for the rapid growth of vertically-aligned carbon nanotubes (exceeding 1 mm/hr) are presented as a specific example illustrating the method's strengths.
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