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Photo-thermal directed assembly

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Micro-patterning of various materials was recently developed based on the laser-induced microbubble technique (LIMBT). LIMBT relies on the formation of a microbubble due to laser heating of a dispersion of nanoparticles (NPs) that absorb the laser light. Natural and Marangoni convection currents carry the NPs to the bubble/substrate interface where some of them are pinned. Moving the substrate relative to the laser beam results in deposition of NPs along a predetermined path. Unfortunately, for many materials this deposition is non-continuous. We have recently found that controlling the construction and destruction of the microbubble through modulation of the laser enables the formation of continuous patterns by preventing the microbubble from getting pinned to the deposited material. Furthermore, we show that microstructure formation from an ion solution could be explained by a similar mechanism. Photo-thermal reduction of the ion solution leads to formation of NPs. These NPs are then pinned to the bubble/substrate interface. This innovative approach can be applicable for producing thin conductive patterns and allow fabrication of microelectronic devices and sensors.

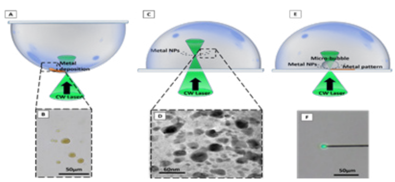

Illustration of deposition processes for different laser focus positions:(A) at the interface between the solution droplet and air,(B) inside the solution and (C) at the substrate/solution interface. The inset in each figure shows the deposits (bright-field microscopy image for A,C and TEM for B)

Notes:

Speaker Biography

Hagay Shpaisman is currently working as a principal investigator in Bar-Ilan University, Israel. In 2013, he serves as a senior lecturer (eq. to assistant professor) at Department of Chemistry & Institute for Nanotechnology and Advanced Materials (BINA), Bar-Ilan University, Israel. Between 2010 – 2013, post-doctoral fellow with Prof. David Grier at NYU, USA and obtained his PhD under the supervision of Prof. David Cahen during 2010 from the Weizmann Institute of Science, Israel. They are fascinated by scientific questions that are at the interface between chemistry, physics and material science. They develop novel methods for bottom-up directed assembly by utilizing optical and acoustic fields. These fields dictate the spatial distribution of materials, their mesoscopic structure and could allow formation of new hybrid materials. A key feature of this approach is its modularity, as it could be implemented on various material systems. Due to the flexibility in material choice, this innovative approach will open the door to new ways to act upon materials, with envisioned applications for electronics, photonics and drug delivery systems.

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