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Directed Material Assembly by Acoustic & Optical Forces

Directed-assembly by applying external fields on materials can set them in a state of local equilibrium with complex spatial organization. Alas, electric and magnetic fields usually require certain material characteristics (conductivity or magnetic susceptibility) that limit the span of possible applications. We present a novel concept based on the idea that mechanical forces arising from optical traps and standing acoustic waves can be used to influence ongoing chemical reactions. These forces dictate the spatial distribution of the materials, their mesoscopic structure, the kinetics of the reaction, and influence the formation of new hybrid materials. This is a paradigm shift compared to other "bottom-up" methods for material assembly that conventionally rely on accumulation of preformed 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.

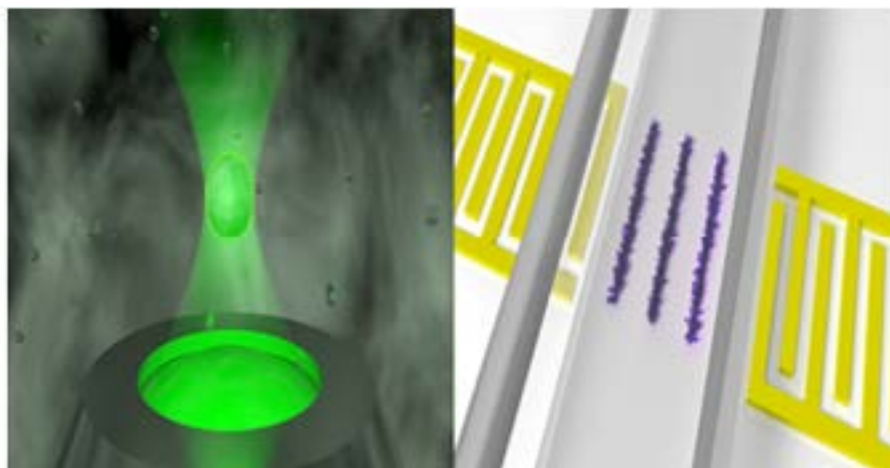


Figure 1: Directed assembly of products of ongoing chemical reactions using (left) optical traps and (right) standing acoustic waves.

Recent Publications

1. N. Armon, U. Greenberg, M. Layani, Y. Rosen, S. Magdassi & H. Shpaisman, " Continuous Nanoparticle Assembly by a Modulated Photo-Induced Microbubble for Fabrication of Micrometric Conductive Patterns ", ACS applied materials & interfaces 9 (50), 44214-44221, (2017)
2. I. Jacob, E. Edri, E. Lasnoy, S. Pipreno & H. Shpaisman, " Influencing Colloidal Formation with Optical Traps", Soft matt., 13 (4), 706-710, (2017)

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3. Omer Wagner, Moty Schultz, Amihai Meiri, Eitan Edri, Rinat Meir, Hagay Shpaisman, Eli Sloutskin, Zeev Zalevsky, " Omer Wagner, Moty Schultz, Amihai Meiri, Eitan Edri, Rinat Meir, Hagay Shpaisman, Eli Sloutskin, Zeev Zalevsky", Transparent Optical Networks (ICTON), IEEE, 1-4, (2017)
4. S. Piperno, H. Sazan & H. Shpaisman, "One-step Acoustic Directed Assembly: From Emulsion Droplets to Polymeric Microstructures", Submitted
5. C. Weng, H. Shpaisman, A. Hollingsworth & D. G. Grier, "Monitoring colloidal growth with holographic particle characterization", Soft Matt., 11, 1062, (2015), Selected for cover image of Feb 2015 issue.

Biography

Hagay Shpaisman received his Ph.D. in Materials Science and Engineering from the Department of Materials and Interfaces at Weizman Institute of Science (Israel). From 2010-2013 Hagay was a postdoctoral researcher at the Center for Soft Matter Research at New York University where he performed research on optical manipulation of colloidal matter. In 2013, he joined the Chemistry Department of Bar-Ilan University (Israel) as an Assistant Professor. His research group is interested in understanding the effect of photon and phonon interactions on the structure and dynamics of colloidal materials and the development of novel field-guided methods for the fabrication of complex structured materials.

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