Researchers propose new gas-solid reaction for high-speed perovskite photodetector

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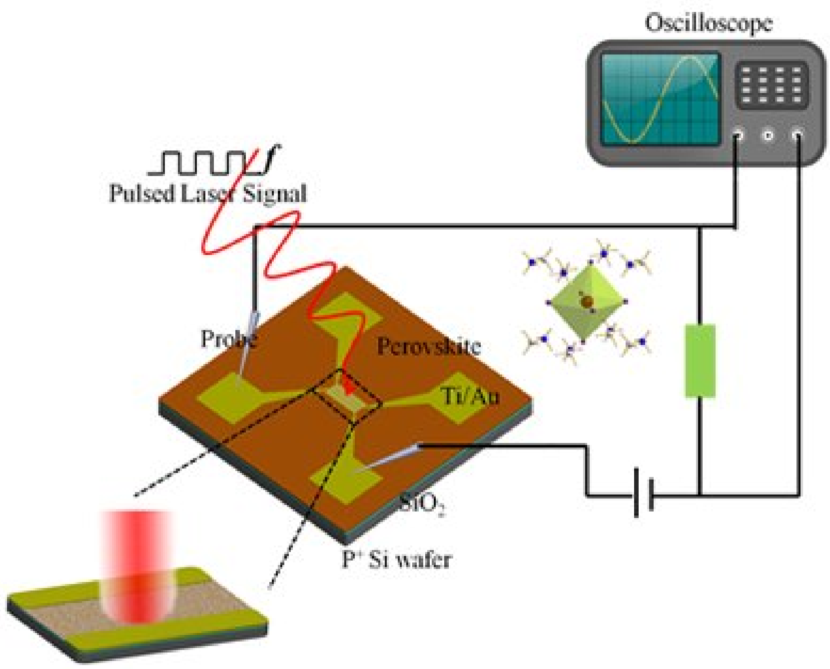

A schematic illustration of hybrid perovskite photoconductivity visible region detector with high speed and high stability. The gas-solid reaction in replace of the traditional solution methods provides a non-solvent environment during the reaction process, constructs a high crystallization and a full coverage film to increase the light capture and transportation, as well as enhance a good stability in the humidity condition, leading to a high response performance for the photodetector. Credit: Dr. Guoqing Tong

A recent paper published in *Nano* showed the gas-solid reaction method provides a full coverage of the perovskite film and avoids damage from the organic solvent, which is beneficial for light capture and electrons transportation, resulting in a faster response time and stability for perovskite photodetectors.

Pervoskite materials have long been considered candidates in the semiconductor manufacturing due to their characteristics of high light absorption, carrier mobility and wider light spectrum. They are widely applied in solar cells, light-emitted devices and photodetectors. However, the organic solvent in the traditional solution method will damage the perovskite film and form unstable phases during the synthesis process, which makes the perovskite film decompose quickly in wet conditions, limiting the practical application of perovskite devices. Considering the significant influence of the solvent, a team of researchers from Dongchang college of Liaocheng University and Hefei University of Technology proposed a new gas-solid process to fabricate the perovskite film. This non-solvent approach provides high crystallization and full coverage film in lower vacuum and low temperature systems.

The researchers investigated the morphology, light absorption and the crystal phases of the perovskite film at the different annealing temperature after gas-reaction to obtain the high-quality perovskite film. The devices exhibited high responsivity and detectivity of 5.87AW-1 and 1012 Jones. The response time of the device is estimated to be 248 μs/207 μs, which is faster than most previous reports via the solution method. Remarkably, the responsivity and detectivity are estimated to be 0.26 AW-1, 2.13×1010 Jones after lasting exposure in air (25^{o}C, RH~40%) for up to two months. This improvement of the stability of the devices demonstrates that the well-controlled vapor deposition method allows a thorough removal of the residual solvents (i.e. DMF, DMSO et. al) and thus effectively promotes a high-quality crystallization of perovskite grains, reducing the metastable phases among the thin films.

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More information: Baoliang Mi et al, Hybrid Perovskite Photoconductivity Visible Region Detector with High Speed and Stability, *Nano* (2017). DOI: 10.1142/S1793292017501508

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