Excellent carrier transport property of hybrid perovskites under high pressures

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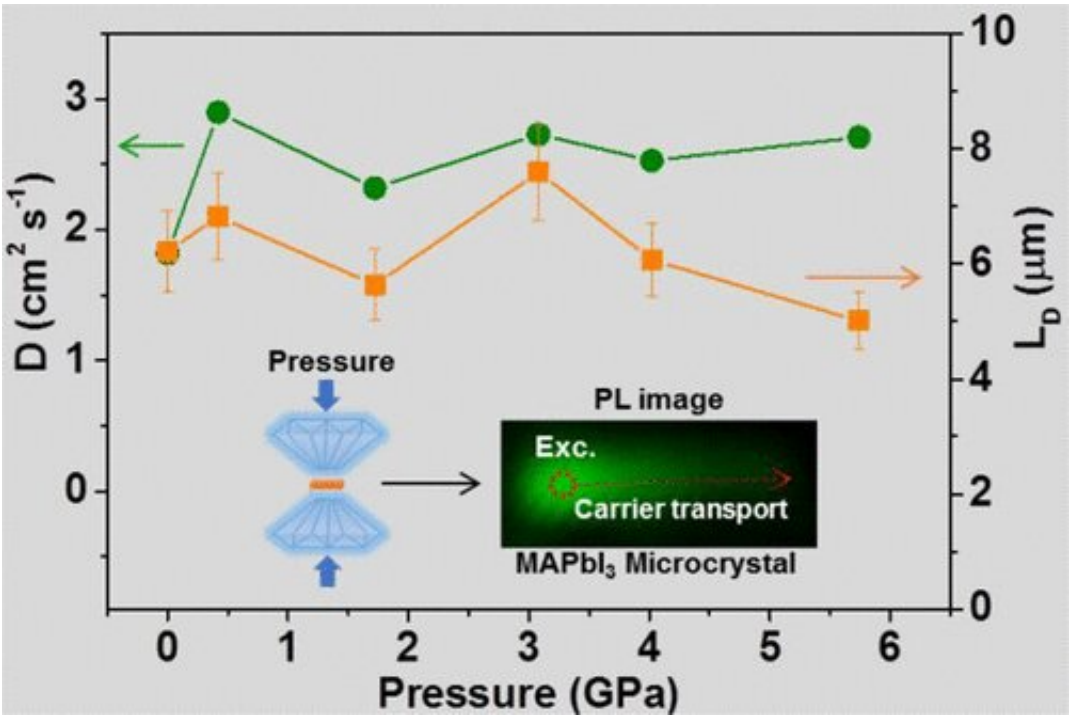

Graphical abstract. Credit: DOI: 10.1021/acsenergylett.1c02359

In perovskite optoelectronic devices, the carrier mobility (or diffusivity) and diffusion length are fundamental properties that determine performance.

However, limited by the small working space in a diamond anvil cell and the inside pressure transmitting media, the measurements of charge

mobility and diffusion length in a diamond anvil cell are challenging by using traditional electrical techniques.

Recently, a research group led by Prof. Jin Shengye from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) revealed excellent carrier transport property of hybrid perovskites under high pressures.

This study was published in *ACS Energy Letters* on Dec. 8.

By combining time-resolved and PL-scanned imaging microscopy with a diamond anvil cell apparatus, the researchers in situ measured the photoinduced carrier transport in $MAPbI_3$ perovskite microcrystals under high pressure up to 5.7 GPa, when the perovskites retained single crystal phase.

They found that the $MAPbI_3$ microcrystals exhibited tetragonal-to-cubic phase transition at 0.3–0.4 GPa and isostructural phase transition at about 3 GPa as the pressure increased.

Moreover, through the direct examination of carrier transport dynamics in a diamond anvil cell, the researchers discovered that the diffusion coefficient of perovskites showed an increase by more than 30% when the pressure was over 0.4 GPa. Combining the corresponding carrier lifetimes, they found the carrier diffusion length (LD) was from 5 to 8 um under different pressures.

This study suggested that the $MAPbI_3$ perovskites could sustain their excellent carrier transport properties under pressure treatment, even though the pressure could cause significant structural defects to the crystal.

"This work sheds light on the influence of pressure on the carrier

transport in $MAPbI_3$ perovskites and paves the way for the utilization of compression to tune or optimize the optoelectronic properties of perovskites," said Prof. Jin.

More information: Yanfeng Yin et al, Excellent Carrier Transport Property of Hybrid Perovskites Sustained under High Pressures, *ACS Energy Letters* (2021). DOI: 10.1021/acsenergylett.1c02359

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