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Surface acoustic wave stimulated charge transport in solids

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Surface acoustic wave stimulated transport of charge carriers in semiconductors and dielectrics could provide a significant increase of the solar cell efficiency. SAWs propagating in piezoelectric crystals have opposite potential values in the SAW minima and maxima due to the piezoelectric effect. The charges are then transported by SAW to the solar cell exit at the speed of sound. In this work, the excited charge carriers were transported to a few hundreds of microns using surface acoustic waves. To visualize the charge transport, the electron beam induced current method (EBIC) was used which permits the visualization of charge distribution on the crystal surface by measuring the current flowing through the sample. Charges introduced by the primary electron beam and those generated in the crystal subsurface area are distributed between SAW minima and maxima according to the potential sign and are then carried by SAW at the acoustic wave velocity to the current collector at the exit. The YZ-cut of a $LiNbO_3$ crystal was used to visualize the acoustically stimulated charge transport. The graphene film was formed on the crystal surface by the transfer technique and the initial graphene was synthesized on the surface of a Cu foil or a Ni film by CVD. Charge distribution on the surface of the YZ-cut of the $LiNbO_3$ crystal was simultaneously visualized by the EBIC method. An EBIC image on the crystal surface during SEM scanning was obtained by measuring the current on the graphene collector. Presents an image of the crystal surface obtained by the EBIC method. shows a periodic structure corresponding to the charge distribution on the crystal surface. Displays the distribution of the EBIC contrast on the crystal surface along the Z axis.

Biography

Zinetula (Zeke) Insepov is an adjunct professor in the School of Nuclear Engineering at Purdue University and a professor in the Department of Condensed Matter Physics at the Moscow Engineering Physics Institute (MEPhI). He is the chief scientist and head of the Nanosynergy Laboratory at Nazarbayev University. He has previously held positions at Albert Ludwig University of Freiburg, Kyoto University, Epion Japan, and Argonne National Laboratory. His research focuses on the fundamental physics of ion beam materials processing, including very-low-energy ion–solid interactions. He developed cluster ion beam interaction simulation programs based on molecular dynamics and Monte Carlo methods. He also predicted a new lateral sputtering phenomenon that is a driving force behind the efficient atomistic smoothening mechanism of surfaces irradiated by large gas cluster ions. Recently, he predicted a nanopumping effect and is developing a new device that allows pump gases and liquids via nanometer-scale channels.

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