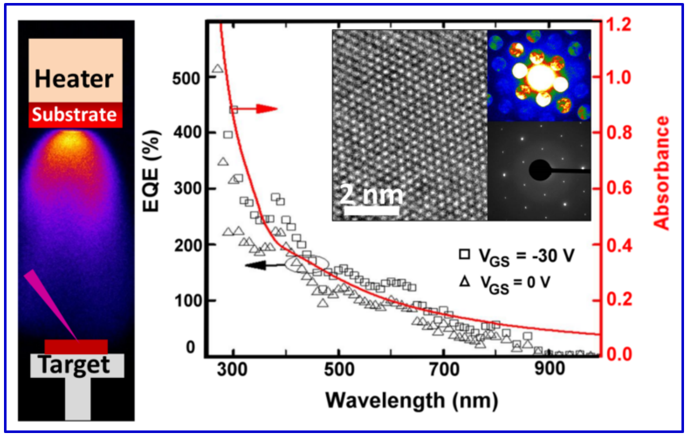
Pulsed Laser Deposition of Photoresponsive Two-Dimensional GaSe Nanosheet Networks



Pulsed laser deposition (left) from a crystalline GaSe target was adjusted to directly grow networks of interconnected triangular GaSe crystalline nanosheets of ~ 200 nm size (inset shows atomic resolution transmission electron microscopy and nanodiffraction). The plot shows the measured external quantum efficiency of the networks which exhibit high photoresponsivity across a broad spectral range.

M. Mahjouri-Samani, R. Gresback, M. Tian, K. Wang, A. A. Puretzky, C. M. Rouleau, G. Eres, I. N. Ivanov, K. Xiao, M. A. McGuire, G. Duscher, and D. B. Geohegan "Pulsed Laser Deposition of Photoresponsive Two-Dimensional GaSe Nanosheet Networks" *Adv. Funct. Mater.* In press. DOI: 10.1002/adfm.201401440

Scientific Achievement

Networks of highly photoresponsive crystalline GaSe nanosheets were synthesized using pulsed laser deposition (PLD) by controlling the kinetic energy and composition of the species in the ablation plume.

Significance and Impact

Controlling the stoichiometry, number of layers, crystallite size, growth location, and areal uniformity of 2D layered material are challenging in commonly used techniques such as chemical vapor deposition. Demonstrating PLD as a method to rapidly explore new layered materials is of significant current interest, as are interesting optoelectronic applications of these materials.

Research Details

– *In situ* imaging and plasma diagnostics were used to adjust the spatial confinement of the plume of laser-ablated target material in relatively high background gas pressures (~ 1 Torr Ar) to form clusters in order to preserve the stoichiometric transfer of material while providing sufficient kinetic energy for surface diffusion.

– High spectral responsivities and external quantum efficiencies were measured from the near-IR to the ultraviolet, ranging from 0.4 AW^{-1} and 100% at 700 nm, to 1.4 AW^{-1} and 600% at 240 nm, respectively.

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Oak Ridge National Laboratory