BAPVC Annual Project Report

Project Title: Thin Film Compound Semiconductor Solar Cells via Templated Growth
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Summary:
This project focuses on a templating approach to allow growth of highly efficient photovoltaic absorbers on low-cost substrates. They use low-temperature layer-exchange metal-induced-crystallization to prepare large-area crystallographically-textured films to template subsequent growth of III-V absorbers. Tapered microwire growth is combined with the template to enhance solar cell performance by increasing light absorption.

Key Accomplishments:
The group has been focusing on low-temperature layer-exchange metal-induced-crystallization to prepare large-area crystallographically-textured films during the past year. They have produced poly-Ge thin film on top of the layered structure at annealing temperature 250C, while the bottom layer is found to be composed of both Ge and Al (Figure 1). Cross-sectional TEM demonstrated the poly-Ge film layer is continuous and all the layers have uniform thickness (Figure 2). The grain size of poly-Ge is found to be around 2.5 um, as shown in the bent contours in both Bright Field and Dark Field TEM images (Figure 3).

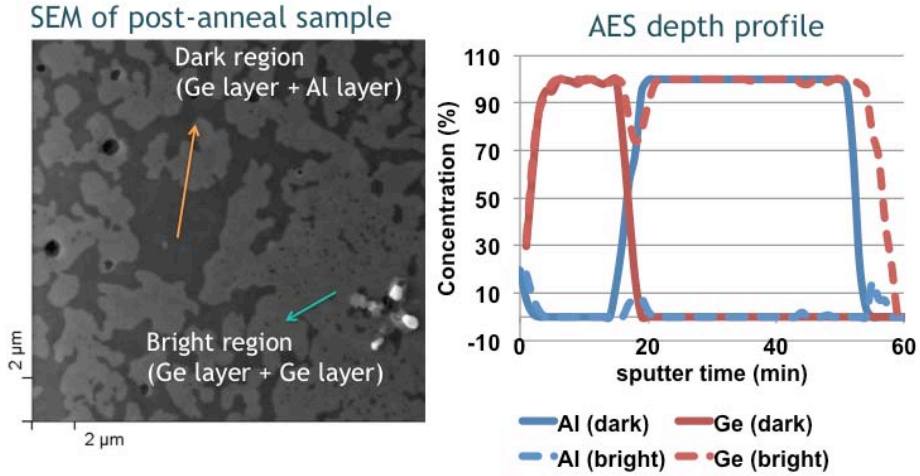

Figure 1. Top-view SEM of layer-exchanged sample (left) showing the different contrasts from the different materials of the bottom layer. AES depth profile (right) showing continuous Ge layer on top, but both Ge and Al in the bottom layer.

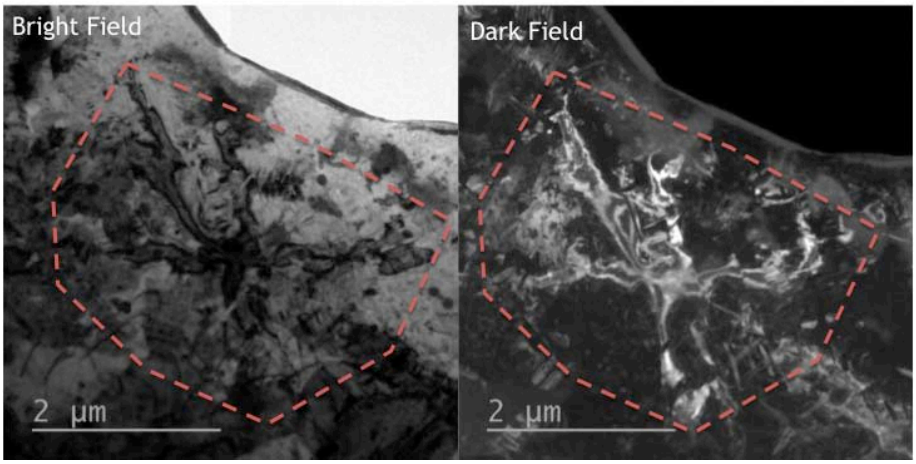

Figure 2. Bright Field (left) and Dark Field (right) TEM images showing the continuous bent contours within one grain of Germanium. The red dashed lines are the estimated grain boundary, corresponding a grain size of 2.5 um.

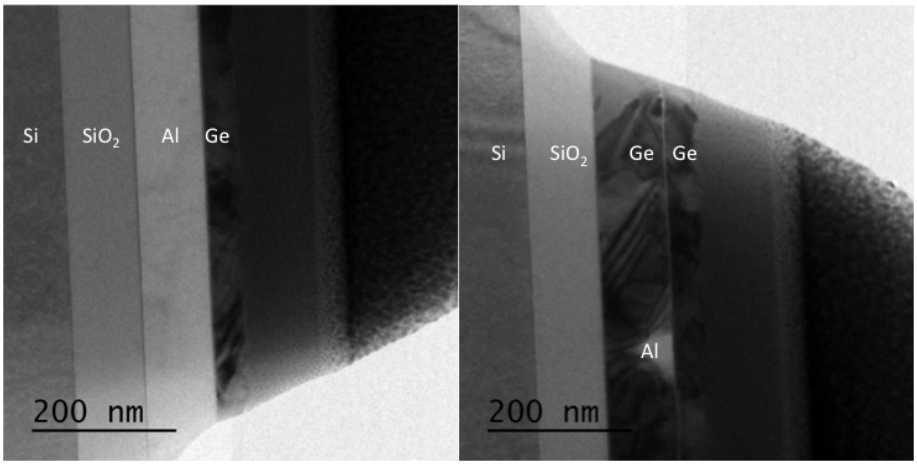

Figure 3. Cross-sectional TEM showing the layer-exchanged structure and the poly-Ge layer is continuous. Some area of the structure is fully layer-exchanged with Al layer under Ge layer (left). Some area of the structure has poly-Ge in the layer under Ge layer (right).

Future Work:

The group will deposit GaAs thin film and Ge core/GaAs shell microwires on the textured poly-Ge template formed on glass, in collaboration with Harris' group at Stanford. The aim is to produce high-efficiency ultra-thin film III-V solar cell on low cost substrate.