Realizing a New *Rutile* Substrate for Epitaxial Film Growth

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Materials discovery is more than calculating the properties that a material should have if the atoms were in desired positions. It is also key to realize the material and control the type, number, and distribution of imperfections to maximize performance. Rutile compounds have exotic functional properties that can be applied for various electronic applications; however, the limited availability of epitaxial substrates has restricted the study of rutile thin films to a limited range of lattice parameters.

Here, a team from the University of Michigan came to PARADIM to grow single crystals of rutile-GeO_2 motivated by their recent discovery of this new semiconductor—with an ultra-high band gap (4.64 eV), high mobility, high heat conductivity, and desired dopability.

Rutile GeO_2 single crystals with high crystallinity are grown by the seeded flux method and, after mechanical polishing, a surface roughness of less than 0.1 nm was obtained. Finally, epitaxial growth on the new rutile GeO_2 substrates was **demonstrated at PARADIM's molecular beam epitaxy (MBE)**. Templating by GeO_2 substrates opens the possibility of stabilizing new rutile thin films and strain states for the tuning of physical properties.

S. Chae, et al. *J. Vac. Science & Technol. A* **40**, 050401 (2022).

Rutile GeO_2—a promising material:

- Identified by theory
- Realized in thin film and bulk form