Project Name: Development of Innovative Solution Growth Technology That Improves Productivity and Quality of SiC Crystals (2020–2023*)

*scheduled

Entrusted parties: National Institute of Advanced Industrial Science and Technology (AIST), The University of Tokyo, Tohoku University

Outline of the project

- Power electronics technology is key component in enabling the large-scale introduction of renewable energy to society by creating an energy network with large capacity storage.
- The silicon carbide (SiC) power electronics market is expected to grow by 30% annually and research and development of SiC devices is increasing.
- On the other hand, the supply of SiC crystal wafers in Japan has not been established. The development of domestic SiC wafer technology is an urgent matter that requires a solution in order for the power electronics industry of Japan to make a leap forward into the future.

<u>High-speed "mm/h" solution growth of SiC</u> (Fig. 1)

- Investigation on novel alloy solvents to strike a balance between high growth rate and growth stability (Figs.2 and 3).
- Development of SiC-saturated growth system to prevent composition instability of solvents, and to make use of novel solvents that have very high carbon solubility.
- Development of a crystal growth simulator that can predict spatial/temporal step bunching distribution.

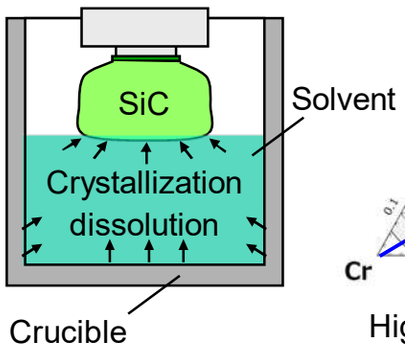


Fig. 1: Solution growth

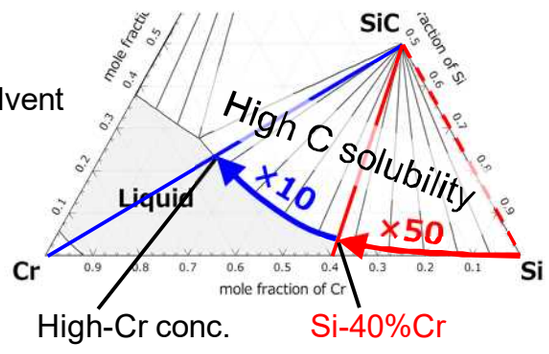


Fig. 2: Si-C-Cr phase diagram

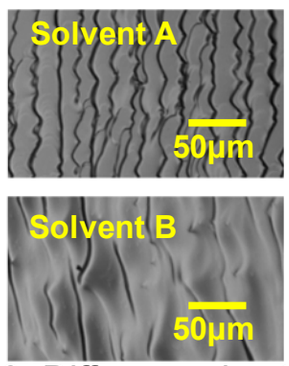
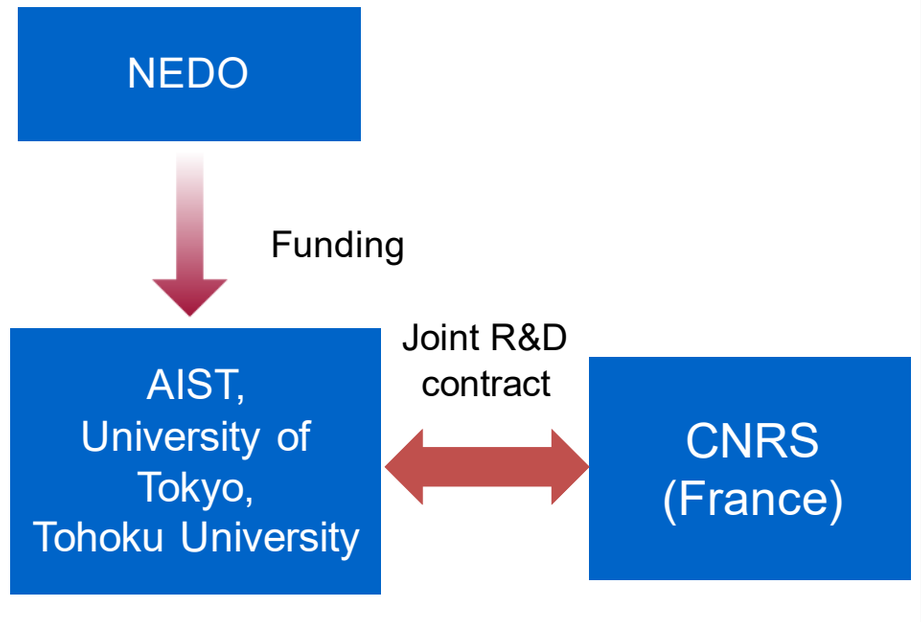


Fig.3: Difference in step-bunching with solvents

Project scheme



Significance of international R&D

- Collaboration with CNRS-SIMaP, which has a strong academic base in high-temperature material science.
- Rapid development of high-speed bulk growth through solvent screening by quantitative evaluation of step-instability.

Expected outcomes

- Reduction of 4600 TWh/year is estimated by the application of SiC power electronics to household and industrial motor drives and inverters, which is equivalent to the reduction potential of 1.4 billion tons of CO_2/year.
- SiC power generation technology contributes to promoting the zero-emission society by playing a central role in energy grid systems for next-generation power electronics, which are essential for the mass introduction of photovoltaic power generation and storage devices.