Pattern Formation and Coarsening in Nanoporous Metals

During the ICC-IMR visit, we collaborated with Prof. Kato's group at the Non-Equilibrium Materials Research Laboratory to investigate liquid metal dealloying (LMD). Initial experiments were conducted on Fe-Ni alloys in liquid Bi, providing a foundation for future studies of more complex dealloying processes and alloy systems, including partial dealloying, high-entropy alloys, and metallic glasses. Our initial results showed distinct grain-boundary penetration and bicontinuous morphologies under different processing conditions. The visit also established plans for synchrotron X-ray imaging at NSLS-II and continued student exchange.

The visit focused on understanding how alloy composition and dealloying conditions influence pattern formation and coarsening in nanoporous metals. Through discussions and experiments with Prof. Kato, Prof. Wada, and group members, we examined Fe-Ni precursor alloys subjected to LMD in liquid Bi. In collaboration with Prof. Yamada, we modified the spin-casting protocol to enable the fabrication of microwire samples suitable for future in-situ synchrotron X-ray experiments on liquid metal dealloying.

Initial microstructural observations showed grain-boundary penetration in Fe:Ni = 50:50 samples processed at 517 °C for 10 min. In contrast, Fe:Ni = 30:70 samples processed at 750 °C for 10-30 s exhibited bicontinuous morphologies **(Fig. 1)**. These observations provide a starting point for investigating morphology selection, the role of grain boundaries, and the coupled effects of composition, temperature, and time.

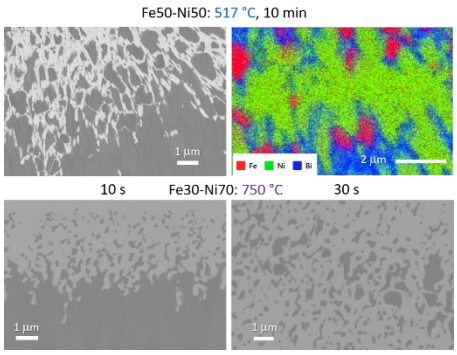


Fig. 1 - SEM images and elemental maps of Fe-Ni alloys after liquid metal dealloying in Bi.

These results suggest a transition between competing kinetic processes governing microstructural evolution in dealloying. Understanding the mechanisms and conditions controlling this transition will be important for predicting morphological evolution in this and other more complex alloy systems.

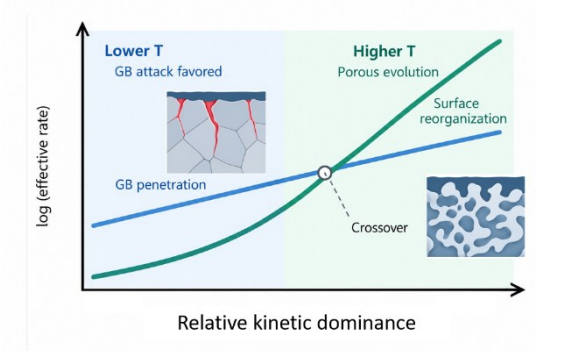


Fig. 2 - Proposed crossover between competing kinetic processes during liquid metal dealloying.

On June 19, 2026, Karen presented "Illuminating Complex Materials through Multimodal Synchrotron X-ray Characterization" at the GP-MS International Seminar, Institute for Materials Research. The seminar and laboratory interactions provided opportunities to exchange research ideas with faculty and students.



Fig. 3 – Photograph from the GP-MS seminar.

Overall, the visit strengthened our collaboration and opened new opportunities for joint research. Next steps include experiments at NSLS-II, Brookhaven National Laboratory, to investigate the kinetic processes governing LMD and related materials processing techniques using X-ray imaging. The collaboration will also continue through a planned research visit by Stony Brook PhD student Carly Zicone, under the GIMRT proposal "Revealing Kinetics and Morphology Selection in Liquid Metal Dealloying through X-ray Microscopy." These activities will support further joint research and potential publications.

Keywords: Kinetics; Morphology; Phase separation

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