

Prevailing surface patterns

Metallurgists, engineers, and others know that when a liquid metal mixture cools into a solid, its constituent elements often separate to form microstructures. An alloy's chemical formula and bulk structure don't necessarily indicate the patterns that form on the surface. Those patterns could be used in various nanomaterials and dynamic surfaces, for example. Jianbo Tang and Kourosh Kalantar-Zadeh (University of New South Wales), Stephanie Lambie and Nicola Gaston (University of Auckland), and their colleagues recently observed highly ordered patterns unique to the surface of a bismuth–gallium alloy. One such pattern is shown here: The light gray parallel lines are each a few micrometers wide.

By tracking the phase transition in real time, the researchers

determined that the patterns formed as a solidification front propagated across the liquid alloy's surface at about 30 $\mu\text{m/s}$. Molecular-dynamics simulations indicated that the rate at which bismuth diffused from the interior to the surface was critical to explaining the observations. Other significant factors included the energetic barriers to crystal formation, the thickness of surface oxide layers, and temperature gradients in the alloy. Bismuth–gallium belongs to a group of alloys known as eutectics: Its melting point is lower than either of its constituents. That makes the alloy potentially useful for optics, electronics, and other applications. (J. Tang et al., *Nat. Nanotechnol.*, 2021, doi:10.1038/s41565-020-00835-7.)

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