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# Are experiments of Metal Pad Roll Instability feasible at Room Temperature?

Caroline Nore<sup>a</sup>, Wietze Herreman<sup>a</sup>, Loic Cappanera<sup>b</sup>, Jean-Luc Guermond<sup>c</sup> and Tom Weier<sup>d</sup>

Aluminium Hall-Héroult reduction cells can be the place of the metal pad roll instability (MPR), ie the growth of gravity waves at the interface between the mixture of cryolite and alumina on top and the liquid aluminium on bottom when a weak ambient magnetic field is present [1]. Combining theoretical arguments and numerical simulations, we demonstrate that this MPR instability can occur in a centimeter-scale setup with reasonable values of the magnetic field and electrical current and with metal pairs that are liquid at room temperature (see Figure 1). We investigate two fluid pairs: gallium with mercury (immiscible pair) and gallium with GaInSn eutectic alloy (miscible pair). We propose an experimental setup and discuss a list of difficulties that can be overcome.

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<sup>1</sup> Sele, *Metall. Mater. Trans. B* **8**, 613 (1977).

<sup>2</sup> Nore et al., *Phys. Rev. Lett.* **126**, 184501 (2021).

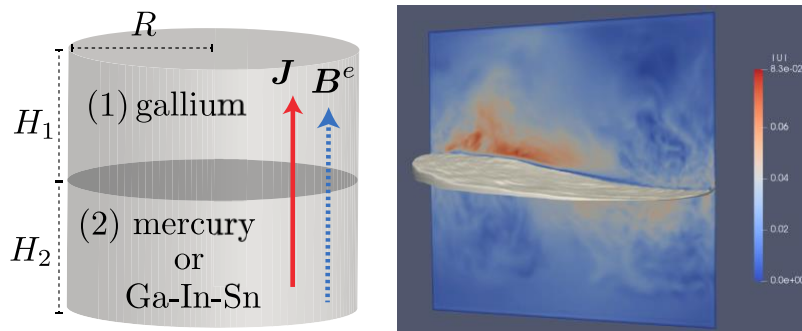


Figure 1: (left) Sketch of the cylindrical setup: a layer of gallium floats on a layer of mercury or eutectic GaInSn alloy, a current  $J$  passes through the cell which is subjected to an external vertical magnetic field  $B^e$ . (right) Interface between the immiscible Ga and Hg setup and turbulent structures in a vertical plane.