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Preventing Damage to Floating Foils Caused by Rayleigh-Taylor Instabilities

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An evaporated metal foil target is often produced on a layer of water- soluble parting agent previously applied to a massive substrate. The foil is then floated onto a water surface by immersing the substrate into a water bath. and is picked up later if the foil survives. During the foil's release, a significant fraction of the dissolved parting agent remains close to the floating foil, as a "heavy" thin layer of solution having higher density than water. This layer of parting agent solution and the lower-density water bath below it form a gravitationally unstable configuration known as a Rayleigh-Taylor instability. If the foil is sufficiently thin, its mass and elastic properties can be ignored, and the motion of the liquids is controlled by only the liquids' properties. This system can spontaneously adjust itself toward stability in several ways, one of which involves rotating a cylindrical liquid cell having a horizontal axis, and its cylindrical surface tangent to the surface. This motion moves part of the heavy layer from the top surface downward. The target maker detects this occurrence by the motions of the foil floating on the top of the bath; if the foil is frail, these motions may result in the crumpling, wrinkling, or tearing of the foil. We have observed such behavior with aluminum foils having thickness of 40 nm on NaCl parting agent, and have successfully implemented methods to prevent such damage.

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