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C3Or2B-03: Why do low conductive coatings increase the cooling speed of metals quenched in liquid nitrogen?

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It is a well-known observation that a low conductive coating on a metal decrease the overall cooling time of a metal when quenched in liquid nitrogen. The early transition to nucleate boiling regime from the film regime is discussed in the literature as the main cause of this enhanced cooling rate. However, till now optimization of the coating thickness to minimize the cooling time has only been an empirical proposition. In this paper, a phenomenological model is proposed that combines the coating properties, thickness, and fluid properties. This model is validated with cooling experiments performed with various specimens in both saturated and sub-cooled liquid nitrogen. A good agreement of the model with the experimental data is found.

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