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The Liquid Aluminum Adhesion Properties to AlCrN Coatings Deposited using Magnetron Sputtering Combined with Femtosecond Laser Surface Texture Treatment

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For conventional Al die casting, it is common to use PVD methods to deposit thin wear resistant ceramic films onto core pins, inserts and loose pieces as a physical barrier to prevent/minimize the soldering that frequently occurs between the Al alloy and the steel dies. In previous studies, we developed a simple aluminum adhesion test (AAT) in an attempt to provide a semi-quantitative assessment of a variety of thin film coatings in preventing such soldering, and the liquid aluminum adhesion properties (sticking behavior) of both uncoated and PVD coated H13 steel coupons were quantified using this approach. The preliminary results indicated that the aluminum adhesion behavior depends on either the coating composition or the coating roughness or both. In an effort to assess the relative importance of these two parameters, AlCrN coatings with varying Al/Cr ratios were deposited using magnetron sputtering onto H13 steel coupons that had been either polished or surface textured using a femtosecond laser. The structural and mechanical properties of these coatings as well as their adhesion behavior with a liquid aluminum alloy were characterized and the results will be presented and discussed. The overall objective is to develop robust coatings for die casting dies that are non-wetting with liquid Al with the long-term objective of circumventing the need to use liquid-based organic lubricants on the steel dies prior to each casting.

Keywords

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