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Deposition of AlCuFeB quasicrystalline coatings by magnetron sputtering

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The Al-Cu-Fe system is known for its quasicrystalline phase. By adding boron, the $Al_{59}Cu_{25.5}Fe_{12.5}B_3$ stoichiometry is promising for its advantageous tribological properties. While there are many techniques available for deposition, perhaps the one most suitable for industrial deposition on complex shapes such as tools remains the magnetron sputtering.
The targets were made by hot pressing of elemental powders. Because the deposition system uses relatively large cathodes, the targets were constructed from ten segments. Tool steels and hard metal were used as substrate. The sample pretreatment was done the standard way: ultrasonic cleaning, heating and ion etching. The adhesion was substantially improved by deposting a TiAlN interlayer, which also prevented diffusion between the substrate and the growing film. Deposition of the AlCuFeB film was done by DC sputtering, using moderate cathode power, standard bias but intense heating. The process itself was stable, yielding a coating with a thickness of up to 3 µm.
The icosahedral phase was achieved on both substrate types, at all the sample geometries, however, always accompanied by a second phase. Compared to the chemical composition of the icosahedral phase it was slightly enriched in Cu and depleted in Al. The microstructure of AlCuFeB was fine-grained rather than columnar as the TiAlN interlayer. The coatings deposed on hard metal suffered from cracks, but on steel substrates they were free from cracks. Wettability studies have been performed on the discussed coatings to identify the effect of the deposition process on the surface energetics of the coating. The coating nanohardness was found to be 10 GPa.

Keywords
AlCuFeB
quasicrystal
magnetron sputtering
TiAlN