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Diamond-like carbon films – preparation techniques, properties and applications

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Diamond-like carbon (DLC) films have several excellent properties like high hardness, high wear resistance, low friction coefficients or optical transparency in the infrared spectral range and a very broad range of electrical conductivities. The generic term DLC covers amorphous carbon with (a-C:H) or without hydrogen (a-C, ta-C) as well as several modifications thereof generated by adding of other elements like metals (a-C:H:Me, a-C:Me), silicon, oxygen, fluorine or others (a-C:H:X). Thus a large variety of properties can be realized. First reports on hard amorphous carbon films were published in the 1950s and about 20 years later began worldwide intensive research activities on DLC. In the following years the number of publications increased continuously and the importance for industrial applications became more and more clear. Several preparation techniques were developed, suitable to deposit metal containing a-C:H:Me, a-C:H and the superhard tetrahedrally coordinated ta-C and also several modifications of these phases. Theoretical models both for ta-C and a-C:H structure and growth, published in the 1990s, supported the optimization of DLC preparation techniques. However, an essential obstacle for a broad industrial application was the high compressive stress level causing delamination and limiting the film thicknesses. With different types of interlayer systems many adhesion problems could be solved satisfyingly. Thus from mid of 1990s first a-C:H:Me and later the harder a-C:H coatings established in the industry, especially to improve the performance of automobile power train components. Furthermore, other promising application fields for DLC coatings will be discussed.

Keywords
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