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Materials Engineering Forum

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Self-lubricating surface layers and composite materials produced by laser alloying and powder metallurgy

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The search for new materials with unique properties, including tribological properties, is very important from the point of view of practical and economic applications. Tribological wear is one of the most common causes of material wear, leading to damage to machine parts or tools. It is estimated to be responsible for 80% of their breakdowns. Approximately 30% of energy is used to overcome frictional resistance. Annual economic losses due to frictional wear account for almost 2% of national GDP. Therefore, studies on friction and the search for new materials, including lubricating oils, greases, and solid lubricants, are a topical issue of important social and economic benefits. With developing industry and modern production technologies, requirements for wear resistance in demanding operating conditions, such as high speeds, high loads, high vacuum, radiation, and operating temperature range, are increased. This means a need to search for new materials, and modification of their surfaces by appropriate treatments. Conducting effective lubrication of the contact surfaces of moving parts is an effective method to counteract friction and reduce their wear. Lubrication oils, plastic greases, and solid lubricants can be distinguished. The lubricating oils, used on a large scale, pollute the environment during their production and, practically, at all the stages of their use: during transport to users, long storage, during work, as well as collection and disposal at the end of the service life. Oils and plastic greases can pose a serious problem in some applications, for example, at high temperatures, when they may evaporate. In addition, they cannot be used for a long time in a high vacuum greater than 10–1 Pa. The solution may be to use solid lubricants. The production of wear-resistant self-lubricating surface layers containing solid lubricants can be one of the most effective and economical methods to increase the durability of machine parts and tools. During the presentation, the results of research on self-lubricating layers produced by laser alloying and self-lubricating materials produced by powder metallurgy will be presented. Wear mechanisms in dry friction conditions of materials containing solid lubricants in their structure will also be presented.

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