CUTTING PERFORMANCE OF DIAMOND-LIKE CARBON COATED TOOL IN CUTTING OF ALUMINUM ALLOYS

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As 6061 aluminum alloy has both a high strength-to-weight ratio and good corrosion resistance, it is used for automobile parts or motorbike parts. In finish cutting at a low feed rate, it has a negative influence on the cutting operation because of continuous chips. Usually, Pb and Bi are added in order to break continuous chips. The chips become brittle because Pb or Bi, which has a low melting point, is dissolved by the cutting heat, and the chips are broken easily. Therefore, free-machining aluminum alloys such as a 6262 aluminum alloy, containing 0.4 ～ 0.7 mass percent Pb and Bi, are widely used. However, from the standpoint of environmental protection, it is necessary to improve the chip breakability without adding Pb. In order to clarify the influence of Si contents added to the 6061 aluminum alloy on the chip control performance, aluminum alloys having different Si contents were drilled by high-speed steel drill. As a result, it was found that Si addition increases chip breaking performance. Next, 6061 aluminum alloy based Al-Si alloys, which have different Si contents, were cut with a high speed steel tool. The tool wear was investigated experimentally. The tool wear increased with the increase of Si contents. There are various methods of surface modification technology for giving wear-resistance to the surface of the material. In surface modification technology, hard materials such as ceramics are coated onto the surface of other material. A diamond-like carbon (DLC) is coated onto the surface of the high speed steel tool to improve the wear-resistance.

In this study, aluminum alloys having different Si contents, were turned by the DLC-coated cutting tool under dry cutting. The chip configurations, cutting forces and tool wear were investigated experimentally.

In this study, three kinds of aluminum alloys were cut with a high-speed steel tool (un-coated tool) or a diamond-like carbon coated high-speed steel tool (DLC-coated tool). The chip breakability, cutting forces and tool wear were investigated experimentally.

The main results obtained are as follows:

(1) The DLC coating layer is effective for decreasing the cutting force.

(2) In cutting Al-2mass%Si alloy, the wear progress of the DLC-coated tool was slower than that of the un-coated tool. And the length of chip with the DLC-coated tool was shorter than that with the un-coated tool.

Based on the above-mentioned findings, adding Si is an effective method of chip control, but the tool wear increased with the increase of Si contents. Therefore, it is necessary that suitable Si content is investigated from viewpoints of chip control performance and tool wear. In addition, an effective tool material must be identified. A suitable Si content is 2% and an effective tool material is the DLC-coated tool in cutting 6061 aluminum alloy.