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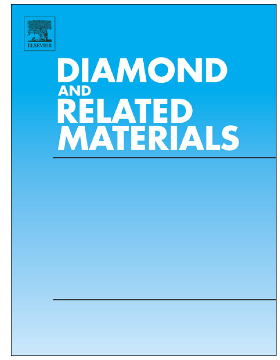

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New Technology for Cutting Ferrous Metal with Diamond Tools

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Abstract: In recent years, cutting objects for diamond tools have gradually expanded from non-ferrous metal and optical glass to ferrous metal materials. Moreover, the requirements of accuracy have continued to increase. To reduce the tool wear of diamond-cutting ferrous metals, a real-time adjustment method using nitrogen cold plasma was proposed. Atmospheric flexible cold plasma jet (AFCPJ) was developed to restrain diamond tool wear by reducing the chemical affinity on the tool–workpiece interface and by adjusting the complex thermal condition in the cutting zone. To obtain better cooling, lubrication, and modification effects, an ultrasonic elliptical vibration cutting device with separation characteristic was designed to promote the entry of the active particles in AFCPJ into the too–workpiece interface. Unlike dry cutting, diamond cutting assisted by cold plasm and ultrasonic elliptic vibration can help reduce the diffusion wear of carbon elements in a diamond tool to workpieces and chips and also effectively reduce the cutting temperature and the surface roughness of the workpiece. Results show that the AFCPJ can significantly restrain the tool wear of diamond-cutting ferrous metals. In addition, the diamond tool wear achieves the best restraining effect when cold plasma and ultrasonic elliptical vibration work together.

Key Words: Diamond Cutting; Cold Plasma; Ferrous Metals; Tool Wear

Nomenclature：

AFCPJ— Atmospheric flexible cold plasma jet

DC— Dry cutting

DCU— Diamond cutting assisted by cold plasma and ultrasonic elliptic vibration

CNPJ— Cold nitrogen plasma jet

DCP —Diamond cutting assisted by cold plasma

DUV— Diamond cutting assisted by ultrasonic elliptation vibration