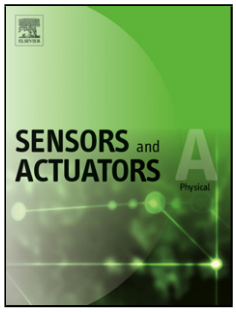

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Built-in thin film thermocouples in surface textures of cemented carbide tools for cutting temperature measurement

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Highlights

- Tools embedded with thin film thermocouples to sense the cutting temperature.
- Thin film thermocouples are fabricated in micro-textures on cemented carbide tools.
- Temperature monitoring is realized in continuous and interrupted cutting tests.
- Good sensitivity and improved durability of the buried sensors are validated.

Abstract

Cemented carbide tools embedded with thin film thermocouples are presented in this paper, to monitor the tool temperature distribution in machining of titanium alloys. In order to protect the thin film sensors from the flowing chips, the fabrication processes which include preparation of micro-grooves on the rake face of commercial tungsten carbide cutting inserts and installation of the thin film sensors in the grooves are proposed. Six K-type thin film thermocouples are implanted in the grooves at a depth of about 100 μm with a 100 μm×50 μm hot junction area. The tests show that the sensors are reliably insulated with the alloy substrate and have good linearity and uniformity in the measurement. The performance of the fabricated inserts are evaluated in a titanium alloy (Ti6Al4V) turning process with the cutting temperature close to the tool-chip interface obtained online for both continuous and interrupted cutting experiments. The fabricated sensors show good sensitivity and improved durability during the cutting processes.

Keywords: Cutting temperature measurement; Thin film thermocouple; Micro-texture; Intelligent cutting tool

1. Introduction

Difficult-to-cut materials such as titanium alloys play important roles in manufacturing of aerospace engine parts due to their superiority in specific strength, heat resistance and

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