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HIP Processing of Improved Tooling Materials for High-Productivity Hot Metal Forming Processes

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Much work has been carried out in the last decade on the development of high performance alloys to reduce vehicle weight. These alloys are often characterized by low room-temperature formability. A variety of hot forming processes (hot stamping, hot extrusion and high-pressure die casting) are thus being used or adapted for these alloys. The final mechanical properties, shape complexity and production cost of parts made using these processes will be closely related to mold/die thermal and mechanical performance.

Hot work tool steels generally have the required mechanical properties and durability to meet hot-processing requirements but have low thermal conductivity. The stringent low processing cost and high-volume production requirements of the automotive industry compel part producers to find ways to shorten unit production times at equivalent product quality. In order to meet the processing requirements of advanced alloys and transfer heat more rapidly, the tooling should thus have a higher thermal conductivity than the standard tool steel dies currently in use.

The aim of this work is to optimize die properties to improve heat transfer kinetics during part shaping, thus providing an increase in efficiency and productivity for automotive metal part manufacturing. Hot Isostatic Pressing (HIP) has been used to clad a conformal-cooled copper core with a layer of either a hot-work tool steel or a High-Thermal Conductivity (HTC) composite material designed at NRC. Properties and performance of these systems are compared with those of standard tool materials to demonstrate the practical potential for future development and optimization of advanced tooling.

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Materials

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