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Development of Optimum Electrodischarge Machining Technology for Advanced Ceramics

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In recent years, ceramic materials with improved properties have been developed to meet a large number of industrial applications. However, in most cases, the cost of the ceramic components is very high. On some occasions, the final machining of the component (especially if complex geometries are to be obtained) accounts for an important percentage of the final cost. The electrodischarge machining process can be a good choice if the material has at least a minimum electrical conductivity, since it can produce very complex shapes and it is not dependent on the hardness or abrasiveness of the material itself. In this paper, the development of sinking and wire electrodischarge machining technology for two ceramics with a promising future (boron carbide and silicon infiltrated silicon carbide) is described. The high removal rates, as well as the possibility of obtaining an excellent surface finish, prove the feasibility of the industrial application of this production method.

Keywords: Ceramics machining; Non-conventional machining; Sinking EDM; Wire EDM

Nowadays, advanced ceramics are found in many fields of application. From sandblasting nozzles to high-temperature heat exchangers, from armour to gas turbine stators, industry is benefiting from the improved properties of these materials. However, the cost of the final component is still very high in many cases, which may reduce the range of application. This high cost may be due to the high cost of the raw material, but also in many cases to the manufacturing process of the component, that may include some machining at the final stage, especially if close tolerances in complex geometries are to be achieved.

In this case, properties that are required in ceramic materials (such as a very high hardness, even at high temperatures), along with their typical brittleness become a major disadvantage. Studies [2] show that, occasionally, the cost of machining a ceramic component is much higher than the cost of the raw material itself. Moreover, final machining is often responsible for damage to the surface integrity of the ceramic component, so it is very difficult to machine at very high removal rates and keeping surface integrity at an acceptable level.