Local material removal mechanisms of cemented carbides in abrasive flow machining

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Abstract. Abrasive Flow Machining (AFM) is a non-conventional finishing operation using a polymeric carrier with abrasive grains commonly used for deburring and polishing complex functional parts. In this process, a small quantity of the polished material is removed during each AFM cycle by pushing and rubbing this viscoelastic medium over the target surface [1,2]. The local abrasive action can be compared to a soft lapping operation as successive abrasive grains carried out by this medium will gently and uniformly abrade the surface and edge. The main benefits are that it is possible to achieve a really fine surface finish with Ra down to 0.4 µm in a short time and especially on difficult-to-access surfaces such as inner contours or cooling channels [3,4]. Extrusion dies are typical parts that require a fine polishing to ensure their performance and tool life. Usually made of cemented carbides (WC-Co), their combination of high hardness, good fracture toughness and high wear resistance makes them difficult to be polished by AFM. If some other studies investigated the wear of cemented carbides under impact or sliding conditions [5,6], the exact mechanism by which the individual abrasive particles in AFM remove the WC-Co is clearly not understood. Therefore, this work proposes to investigate the local deformation and wear mechanisms of WC-Co when submitted to an AFM operation. A systematic experimental study has been performed on an Extrude Hone AFM machine. A specific set-up has been developed to relocate the specimen between two AFM cycles in order to follow the surface feature evolutions. FEG SEM and EDS analyses have been carried out to propose a qualitative mechanism on a micro-scale. Intra-granular cracks, generation and compaction of wear debris have been emphasized confirming their brittle wear behaviour even under a soft polishing process.

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