ABSTRACT

Diamond coated cutting tools are the new generation tools which combine the strength of both single crystal natural diamond and polycrystalline diamond(PCD) cutting tools. One of the significant roles played by diamond tool is efficient dry machining of low strength low melting point materials like aluminium which otherwise sticks to almost all conventional uncoated and coated tool leading to heavy material built-up at cutting edge. This built–up edge not only enhances cutting force but also causes poor quality surface finish on the workpiece. On the other hand a dense, smooth and well adherent diamond coating grown on the carbide substrate not only makes a high performance tool but also become a potential substitute of costly PCD cutting tools. The first and important step in the growth of CVD diamond coating is nucleation. The CVD process parameters, substrate pretreatment, seeding materials are expected to affect not only nucleation but also growth, morphology and purity of CVD diamond coating and its adhesion to the substrate and ultimately performance of such coating in cutting tool application. In this respect, the informations available in the literature were often found to be inadequate, less informative or even contradictory in nature. The present investigation was directed to conduct a systematic study on effect of process parameters, various surface treatments and different seeding materials on the coating characteristics. A detailed study has been made on the effect of deposition pressure on nucleation and growth of diamond coating on as received, pretreated substrates and substrates seeded with different materials. The effectiveness of deposition pressure, surface treatments and seed material was also evaluated by adhesion test. The improved inertness of diamond coating relative to uncoated carbide towards aluminum was assessed by wetting characteristics. The improved performance of the diamond coated carbide tool relative to uncoated carbide tool during dry machining of aluminum was also established through reduction of cutting force and surface roughness of work-piece. However, CVD diamond coating with higher thickness and improved adhesion at the cutting edge by control of process parameters and proper cutting edge preparations needs further study.