Improved Characterisation of PCD to Emulate Real Failure Modes

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In real world applications (e.g. rock drilling), polycrystalline diamond (PCD) cutters have exceptional wear resistance. However, at a certain point in their operational cycle / under certain conditions, cutters can fail catastrophically. Rather than steady abrasive wear, these failures correspond to large scale crack propagation and fracture in the cutter. The origin of the onset of such failures is unclear, which makes it difficult to design cutter materials or operational conditions that help avoid such failures. Current testing methods for PCD cutters (e.g. VB test) are intended to be representative of the application, so integrate many effects together (wear/abrasion, impact, temperature), which makes it difficult to elucidate the underlying physical processes. Further, the testing methods are still not necessarily representative of the extreme conditions in the application environment (pressure, temperature, chemical environment). Finally, the long service lifetime of cutters necessitates test acceleration – which is also a poorly understood process.

We anticipate the outcomes from the project will be (i) New instrumentation and a new test methodology to perform advanced characterisation of PCD under multiple impacts, at varying temperatures; (ii) New insights into the impact failure conditions of PCD, and the underlying physical process, and how they change with respect to temperature; (iii) An improved understanding of the relationships between PCD degradation due to impact, erosion and abrasion. There will be significant potential impact through reduction in failure of PCD components and an improved ability to develop failure resistant materials and components.

The project involves collaboration with Element Six Ltd – the world leader in advanced diamond technologies.

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