

Smart sensor technologies for diamond/cBN tools

Smart tool technology offers a huge range of advantages in machining - higher throughput, more consistent finish, more predictable tool life, and new machining capabilities in terms of geometries and mixed material work pieces. In both polycrystalline diamond (PCD) and polycrystalline cubic boron nitride (PcBN) cutting tool applications, a key parameter in tool/process failure is the temperature of the cutting tool. This is particularly true in dry machining applications. Modern composite materials may need to be dry machined to avoid damage, and as they are very abrasive thermal failure is the major process limitation. Current smart tool development is focused on adding sensors, either to the tool holder or printed on the tool. This technology can be substantially limited by the remoteness from the actual cutting tip - typically only providing some proxy for the cutting forces.

The luminescent, Raman and other optical properties of diamond, PCD and PcBN materials offer unique opportunities to make temperature and force measurements close to the cutting tip, but fundamental research is required to find the most practical and valuable solutions.

This PhD will assess the accessible properties of diamond, PcBN and PCD tools for making useful cutting tool measurements, develop solutions to utilising these properties in practical applications, and then use the data provided by the tools to develop our understanding of the cutting applications themselves, enhancing the overall cost effectiveness of precision machining. This project is jointly funded by the DST CDT and Element Six, and the work at Warwick will be carried out in collaboration between the Warwick Manufacturing Group (WMG) and Physics. As this field is wide open at present, the PhD student will be able to substantially influence the direction of the project, contribute to a real market application, quite possibly develop new Intellectual Property, and become skilled at expert level in what will be a crucial area of engineering science over the next 20 years.

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