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Investigation of Fatigue-Type Processes in Polycrystalline Diamond Tools Using Raman Spectroscopy

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Abstract content
   (Max 300 words)
Formatting &
Special chars

Polycrystalline diamond (PCD) cylindrical tool-bits used in oil well drilling are susceptible to fracture due to the hostile environment of randomly occurring impact loads to which they are subjected. The fact that the tool-bits fail after repeated use suggests the possibility of fatigue type processes in PCD. The study of stress fields on the surface of the PCD thus becomes crucial in the quest to have extended lives for these tool-bits. Since the diamond Raman peak reveals both the nature and magnitude of the stress present in the material, this technique can be employed as a non-destructive measurement tool to investigate these stress fields.

Raman stress measurements at room temperature were carried out using a 36 point mapping array in area close to the size of the PCD samples. The mapping points provided histograms of the magnitude and nature of these small individually stressed regions showing a general compressive stress for the lower numbers of fatigue cycles which deteriorates to a high proportion of tensile regions. The data are also illustrated by 2-D surface maps as an alternative mode of presentation again confirming the change from surface stresses being dominantly compressive to dominantly tensile with exposure to the higher numbers of fatigue cycles. Whereas a general compressive stress is desirable in the PCD layer as it inhibits the propagation of cracks, on the contrary tensile stresses facilitate the formation of cracks ultimately leading to catastrophic failure of the tool-bits.

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PhD

Main supervisor (name and email)
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