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An all-optical system designed for the heating and temperature measurement of the diamond tool

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Abstract content
   (Max 300 words)

A diamond tool is used in industry for abrasive applications such as grinding, and drilling. One of its important applications is in drill bits used for drilling through rock in search of oil. The early failure of drill bits used in oil drilling rigs has huge financial implications. Therefore, we have undertaken a study trying to understand this problem and solving it by applying the science of light. In this work we outline how a non-contact of an all-optical system was designed for the heating and then subsequent temperature measurement of the diamond tool. A laser beam was used as the source to raise the temperature of the diamond tool, and the resultant temperature was measured by using the blackbody principle. It has been demonstrated that the temperature profiles across the diamond tool surface using two laser beam profiles and two optical setups, thus allowing a study of temperature influences with and without thermal stress [1]. The generation of such temperature profiles on the diamond tool in the laboratory is important in the study of changes that occur in diamond tools, particularly the reduced efficiency of such tools in applications as rock drilling where extreme heating due to friction is expected. The results show that laser heating does not result in graphitization of the diamond tool, but rather cobalt and tungsten oxides form on the diamond tool surface [2].

Keywords: Laser heating, thermal stress, diamond tool.

[1] BN Masina et. al., “Laser beam shaping for studying thermally induced damage”, Proc. SPIE, pp 81300 H-1 – 81300 H-12, 2011.
[2] BN Masina et. al., “Thermally induced defects in a polycrystalline diamond layer on a tungsten carbide substrate”, Phys. B 404, pp 4485 – 4488, 2009.

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