NANODIAGNOSTIC METHOD OF MICROCRACK SIZE ESTIMATION FOR PIPELINE CORROSION MONITORING

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Abstract

Pipeline corrosion is the major threat of the oil and gas transport infrastructure in harsh climate regions such as Ural and Siberia in Russia. There are many various non-destructive testing methods available for monitoring of corrosion in oil and gas equipment. Dye penetrant methods are among the simplest and the cheapest ones [1]. Unfortunately, this method is not applicable for rough surfaces, its contrasting ability is low, and the microcrack size estimation is unavailable. We developed the modified penetrant method, in which photoluminescent metal nanoparticles are used as the penetrant, and the visual inspection is replaced by the mapping of nanosized defects contrasted by nanoparticles.The developed method is based on the detection of nanoparticles photoluminescence (PL) and second harmonics generation (SHG) [2] with excitation by femtosecond near-infrared (NIR) laser. PL and SHG of gold and silver nanoparticles are then detected in visible part of spectrum. Varying the size of nanoparticles used as penetrant, it is thus possible to selectively contrast the microcracks of size larger than nanoparticle size. The developed method will allow to map the microcracks distribution on the sample surface and to differentiate minor surface defects from deep microcracks.

Keywords: nanodiagnostics, nanoparticles, photoluminescence, microcracks, non-destructive testing

ACKNOWLEDGEMENTS

This work is supported by Ministry of Education and Science of the Russian Federation (Target funding, project 1256). The authors are grateful to Ivan Tiunov and Maksim Gorbachevskii for help with nanoparticles synthesis.

Author did not supply full text of the paper/poster.