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Inspection Method for Delamination Defect in First Wall Panel of Tokamak Device by using Laser Infrared Thermography Technique

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First wall panels (FWP), which adjoins along the inner wall of the vacuum vessel (VV) of Tokamak device, are multilayer structures different materials welded by solid welding technique to perform heat exchange enhancement, VV protection and tritium breeding functions. In order to implement online inspection of the delamination defect of FWPs nondestructively, a NDT method capable to make inspection without accessing into the VV (through the VV window) is necessary. In this paper, a laser infrared thermography testing (LIRT) method is proposed to deal with this problem considering its features of remote sensing, non-contacting and high detection efficiency. To check its feasibility under practical inspection environment, several inspection modes are considered based on the practical structure and size of FWP and VV in EAST Tokamak device. Different distances and angles of FWPs to the LIRT transducers are considered to investigate its detectability for FWPs at different positons. A laser infrared thermography testing experiment system is established and several double-layered plates with different artificial delamination defects are inspected according to the selected testing conditions. In addition, several image processing methods including pulse phase method (PPT), principle component thermography (PCT) and thermography signal reconstruction (TSR) are adopted to enhance the detectability. In this way, the feasibility of the LIRT method for inspection of delamination in FWPs is clarified. Finally, In addition, an online inspection procedure for delamination defects in FWPs through VV windows in practical condition is presented.

Eligible for student paper award?

Yes

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