

## **Effect of Air-Gap Thickness on Debond Detection in Coatings using Pulsed Thermography: A Numerical Study**

Sharath D<sup>\*1</sup>, Ajay Rawat<sup>1</sup>, M. Menaka<sup>1</sup>, B. Venkatraman<sup>1</sup> and Baldev Raj<sup>2</sup>

<sup>1</sup>Indira Gandhi Centre for Atomic Research, Kalpakkam 603 102, India

<sup>2</sup>National Institute of Advanced Studies, Bangalore 560 012, India

\*[sharath.universe@igcar.gov.in](mailto:sharath.universe@igcar.gov.in)

In industries coatings have become important part of system which protect the structural materials from hazardous and corrosive environment by improving its surface properties. Coatings need to be characterised for thickness, adhesion strength and debonds, before it can be used in the field. Debond is the most common type of defect which occurs in coatings, which is the lack of chemical bonding between coating and substrate leading to separation of coating from the substrate.

Pulsed Thermography (PT) has been widely used for defect characterization, coating thickness evaluation and material characterization. PT has the advantage of fast inspection rate and is non contact in nature. The air gap thickness has effect on the temperature signal produced during the PT testing. If the air gap between coating and substrate is small, thermal waves will pass through the air gap, in addition to going around it. This will lead to weak signals on the surface and the debond might be undetected. In metallic coatings air gap has pronounced effect since highly diffusive coatings make it difficult to measure the IR signals. Hence it is important to study the effect of air gap thickness on surface temperature response in PT.

In the present study, NiB coating system on AISI type 316 L Stainless Steel substrate was considered. NiB coatings are one of the most widely used coatings in aerospace, nuclear, chemical industries due its good corrosion, wear resistance and excellent hardness. Numerical simulation was carried out for studying the effect of air gap thickness on temperature response using ThermoCalc 6L software. Then the experiment was carried out on the 50  $\mu\text{m}$  thick NiB coating system. Immersion Ultrasonic Testing was carried out to validate the debonds in the coating.

**Keywords:** Debond, Air Gap Thickness, Pulsed Thermography, Numerical Simulation