Seminar

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Institute for Plasma Research

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Title: Feasibility study of coating on carbon electrode surface for molten aluminium wettability

Speaker: Dr. Akash A. Vyas
Institute for Plasma Research, Gandhinagar

Date: 15th May, 2024 (Wednesday)

Time: 3.30 PM

Venue: Committee Room 3, New Building, IPR

Abstract:

The wetting of carbon electrodes by molten aluminium in smelters is a critical step which influences the energy consumption as well as CO_2 generation. Based on this, a sponsored project with an aluminium smelting industry was undertaken to explore how the surface or bulk modification of carbon electrodes can be made to enhance the wettability.

The work done in first year includes exploring various approaches to enhance the wettability between graphite and molten aluminium, especially with using carbides such as Ti-C / MAX phase (Ti3AlC2), Nickel as intermediate layer etc. Several approaches such as coating of C electrode with titanium (Ti), pressure less sintering of a Ti_3AlC_2 coating on graphite, functionally graded materials via spark plasma sintering, laser assisted surface cladding of metallic coatings on graphite. The coated samples were also subjected to molten cryolite test which demonstrated comparatively better performance of nickel-coated graphite substrate. In summary, the nickel-coated graphite, especially through the DED method, appears promising. The status of the work done shall be presented. The treated surface of optimized samples needs to be tested and validated for wettability change using molten metal based hot contact angle measurement setup which is to be arranged by the industry collaborator.

As a next course of action, apart from the wettability investigation with the industry collaborator, IPR shall investigate the feasibility of using metal (e.g. Ni) coated graphite powder as with normal carbon substrate using hot pressing. Required processing using hot pressing/SPS and its characterization (SEM, XRD, Raman) shall be conducted followed by which the wettability studies will also be undertaken.

Keywords: Aluminium Production, Wettability, Laser Cladding, Functionally Graded Material, Nickel Coated Graphite, MAX Phase