International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

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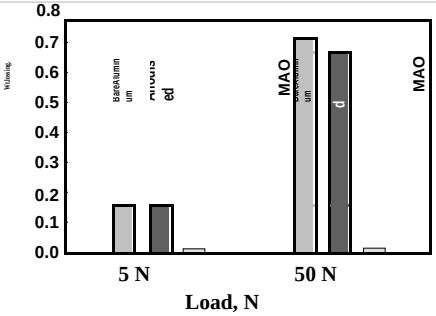
Micro Arc Oxidation Coating Technology

Overview

Micro Arc Oxidation (MAO) also known as Plasma Electrolytic Oxidation (PEO) is a novel and environmental friendly way of creating dense, ultra-hard (peak hardness up to 1800 HV) ceramic composite coatings for enhancing the wear, corrosion, electrical and thermal protection of Al alloys. MAO is an electro-chemical and electro-thermal oxidation in an alkaline electrolyte and the surface oxidation is driven by the supply of high voltage (up to 600 V) pulsed AC power. MAO coatings deposited on a large variety Al alloys such as 3-times harder, 15 times wear resistant and 10 times corrosion resistant than the hard anodized layers. Further, MAO technology can treat the difficult to anodize class of alloys such as Al-Si cast products. Through rigorous R&D activities pursued over last 2 decades, ARCI has mastered over the MAO process including the equipment design, building, testing, supply, installation and commissioning of academic scale, lab scale and industry scale systems with custom built capacities and capabilities.

Key Features

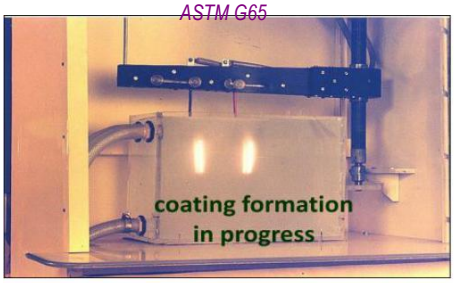
- Custom-built technology systems are available in large power supply ranges between 20 to 500 kVA depending upon the scale of operations
- Apart from a variety of Al alloys, coatings can also be formed on metallic components made out of Mg, Ti, Zr and their alloys
- It is possible to engineer the coating composition through additives added to the electrolyte depending upon the functional requirements of various industrial components
- Coating hardness increases with increasing thickness due to concurrently increased alpha alumina phase in the coating structure



Superior abrasive wear performance of MAO coatings as against the hard anodized coatings against silica abrasive as per ASTM G65

Potential Applications

- Taking advantage of enhanced fatigue strength in addition to the wear, corrosion, thermal and electrical protection, numerous applications ranging from automotive, aerospace, wire drawing and textile industry are the potential segments
- Although the MAO process is discrete, continuous coating deposition technology developed on the basic platform of MAO coating formation is useful for providing an insulating coating on foils and wires of kilometer long is useful for electrical and electronics application.



Intellectual Property Development Indices (IPDI)

- Prototype models of academic and industry scale systems were already fabricated, tested and demonstrated on a variety of applications, installed at customer locations.
- Application development for various industry segments is currently in progress to promote more technology transfers to the Indian industries and universities.

MAO coated heavy duty automotive piston for thermal corrosion protection and textile disc for reducing the friction under high speed, high stress abrasion, sliding wear modes

Status	1	2	3	4	5	6	7	8	9	10

Major Patents and Publications

1. Indian Patent Applications: (a) 209817, (b) 1828/DEL/2008/01082008, (c) 1839/DEL/2015, US Patent Applications: (d) 6,893,551, (e) 8,486,237, (f) 9,365,945 UK Patent Application: (g) GB2464378, Japan Patent No: (h) 5442386, German Patent No: (i) 10 2009 044 256, French Patent Application: (j) 0957102, Brazil Patent No: (k) PI0904232-6 A2 and South Africa Patent No: (l) ZA200906786.

2. L. Rama Krishna et. al., *Surface and Coatings Technology*, vol. 163-164, 2003, pp. 484-490, *Wear*, vol. 261, 2006, pp. 1095-1101, *Surface and Coatings Technology*, vol. 167, 2003, pp. 269-277.

3. L. Rama Krishna et. al., *Metallurgical and Materials Transactions A*, vol. 38, 2007, pp. 370-378, *Surface and Coatings Technology*, vol. 269, 2015, pp. 54-63, *Journal of Alloys and Compounds*, vol. 578, 2013, pp. 355-361.

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