

An Efficient Tool for Environment-Friendly Cleaning Process

Advanced Plasma Coating Technology-Competitive Niche in Industry

Three advanced plasma coating techniques have been developed recently in the plasma engineering laboratory at the Institute of Nuclear Energy Research (INER), the research arm of the Atomic Energy Council (AEC). Three major functions of these technologies have been demonstrated. The first one is the greatly enhanced wear-resistant and anti-corrosion capability of the screw rod, which is the key tool of plastic injection formation manufacturing industry. The second one is the effective replacement of the toxic cadmium coating to prevent environmental pollution. And the third one is the establishment of key materials, flexible transparent conducting films, in touch panel industry for manufacturing self-supported product policy. As plasma coating is a clean process, the responsibility of environmental protection accomplished at the same time.

Conventional screw rods, used in injection formation manufacturing to compress molding plastics mixed with chemicals, are likely to be worn and eroded. Therefore, their service life is short. By employing a recently developed “high power impulse”, coating technology to deposit a high dense and strongly adhered films on the surface of screw rods to enhance its wear-resistant and anti-corrosion capability so that its life is increased to better than 3 times, much superior to the function achieved at present by any other coating technology. Thus, the related production efficiency can be increased significantly. In the aerospace industry, electroplating with the cadmium metal layer is used over a long period of time for their fastening screw bolts and nuts to resist the corrosion effect induced in the fastening contact of the screws with other metals. The toxicity of cadmium pollution to our environment has been well known to us. An innovative plasma coating of aluminum, employing plasma assisted metal vapors to cover a thick layer of aluminum metals, has been demonstrated to have the same level of contact corrosion resistant as cadmium electroplating and verified by the military specification of MIL-83488C. Thus, the toxicity of cadmium in environmental pollution can be effectively prevented. Most of the key materials “flexible transparent conducting films” in the most popular touch panel industry with high light-transparent and high conducting characteristics are imported. The roll-to-roll plasma coating of Indium Tin Oxide (ITO) Films at room temperature has been developed at the INER to meet the market requirements in its light transparence, electric resistivity, and to employ the complete self-supported techniques so as to reduce the production cost dramatically.

Surface engineering techniques have long been developed at the INER, using plasma to meet environmental protection requirements. At present there are over 20 pieces of industrial plasma coating equipment in operations under INER’s authorization for the civilian applications. These include the plasma coatings of the construction materials of building, bath components and various metal components for the decoration and protection purposes. Good comments have been given by these apparatus owners. Now with the three newly developed advanced plasma coating technologies, more owners in the industry will be benefited. All techniques in the whole production line, including the plasma generation technology in the upstream, plasma coating apparatus and manufacturing processes in the middle

stream, and the final products in downstream, are completely controlled at one go by the INER. In the future, we will match up the market variation to continue to develop more innovative and practical integral solutions for industry. We expect to assist more local industry to upgrade their manufacturing techniques and qualities, and to make more contribution in the environmental protection as well.

【Brief dictionary of news】

- 1. Plasma ; Plasma coating ; Roll-to-roll plasma coating :** In addition to solid, liquid and gas states, the materials of our universe can also be in the fourth state, i.e. plasma state. It is a collection of electrons, ions, neutral and active particles and emits lights due to its energy. Sun and lightning in our universe are all in plasma states. Artificial plasma can be generated via gas discharge. The fluorescence light is the mostly commonly plasma in our daily life. Plasma TV is another example. The deposition of the elements in the plasma state on the surface of substrate is plasma coating, which is a dry process and meets the requirements of environmental protection. For the plasma coating of flexible materials such as rolls of plastics, it has to be done by rotating the roll of plastics into and out of the plasma coating area, i.e. roll-to-roll plasma coating.
- 2. Indium Tin Oxide films(ITO-films) :** Plasma coating of varied composition of indium and tin oxide films on the glass makes film both transparent and conducting. Thus, it is required in flat panel industry such as LCD and mobile phone. However, for touch panel the flexible transparent plastics coated with this ITO film are also required, with both transparent and conducting functions. The flexible transparent plastic films coated with ITO layer are called ITO-films.
- 3. MIL-83488C :** A military specification of aerospace components for the verification of the protection layer for corrosion resisting function in salt vapors
- 4. Contact corrosion :** When different metals are in contact over a long period of time, rapid corrosion will be induced on the contact area due to their different chemical potentials ◦

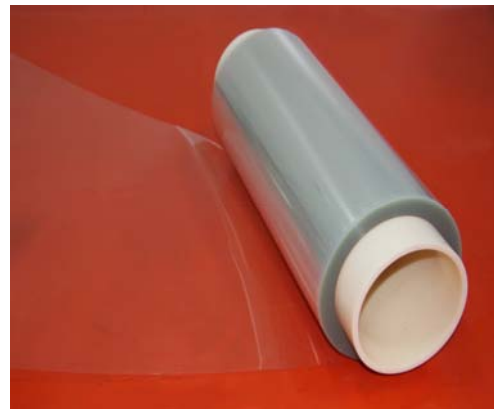
【Figures & photos】



Wear-resistant and anti-corrosion screw rods by high power impulse plasma coating



Contact corrosion-resistant aerospace components by plasma coating of thicker aluminum



High function of flexible transparent and conducting ITO-films by roll-to-roll plasma coating