

Investigation on variable involved in electroding of high voltage Zinc Oxide varistors by Aluminum spraying

By: Hamidreza Soleimanpour

This thesis was a part of a national project on localization of high voltage varistors supporting by Iranian ministry of power.

Zinc Oxide ceramics due to their variable electrical resistance have wide application in electricity transformation and distribution plants, electrical circuits as surge arrestor and voltage stabilizer. For connecting this electronic ceramic to other element in electrical circuits, electroding of Varistors is necessary. Electroding of varistors is a critical step in manufacturing process and has great effects on varistors performance. Thermal spraying is an economical process for electroding of high voltage varistors. Some parts of review literature section are:

- 1- Adhesion mechanisms of metal to ceramic in application of electroding of electronic materials.
- 2- Industrial and laboratory processes for metallization of ceramics.
- 3- Process parameters in thermal spraying for electroding of high voltage varistors.

Practical investigations that have been done in project are:

- 1- Effect of different methods for surface preparation of ZnO ceramic (roughening).
- 2- Effect of surface cleaning on bonding strength using chemical agents and ultrasonic cleaning.
- 3- Effect of spraying parameter on morphology of coating, oxidation level and bonding strength.
- 4- Effect of etching time and acid concentration on surface roughening in surface preparation process.
- 5- Investigation on adhesion mechanisms in thermal spraying process.

Some laboratory test that have been done:

- 1- Metallographic study on bonding in metal/ceramic interface.
- 2- Measuring of porosity level in different spraying conditions by image analyzer.
- 3- SEM studies for:
 - 3-1- Interface condition
 - 3-2- Sub layer degradation in ceramic during surface preparation.
 - 3-3- Morphology of roughed surface (before and after surface treatment)
 - 3-4- Morphology of Al electrode on ZnO
- 4- Measurement of surface roughness after roughening.
- 5- Measurement of Al/ZnO bonding strength according to pull of method (ASTM D4541).

Some results of project are:

- 1- Effect of acid on surface roughness and shape of roughed surface, plus application of a cleaning method have strong effects in bonding strength.
- 2- Spraying in an inert atmosphere such as Ar is essential to lowering oxide content in electrode that has strong effect on bonding strength and breakdown voltage.