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"Arc and Plasma Spraying Today and in the 90th"

Prof. H.D. Steffens

Question (*Dr. S. Amada*) :

In these years, I am studying about ceramic coatings by plasma spraying, particularly its pore structures and its application to heat engines. Please allow me to ask my questions based on that point.

1. To improve plasma spraying technique it is required that the spraying process should be clarified based on the theoretical model, in particular, behavior of plasma jet, interactions between plasma jet and introduced particles, velocity and temperature of the particles residencing in jet, flattening process of the particles on the substrate and so on. What do you think of my comment?
2. In applying ceramic coatings to heat engines, such as TBC and insulating components in diesel engines, zirconia is the most attractive candidate because of low thermal conductivity. To realize, there exist several problems, for example, low adhesion strength, limited thickness of coating layer, instability of partial stabilized zirconia under hot flame. Is there any powerful approach to get over these barriers?
3. To drive researches and developments of plasma spraying technique further, we must have effective and simple evaluating methods of coating layer, which should be not only nation-wide but also world-wide acceptable methods. Do you have any idea about this point?
4. You presented recently developed hardwares of plasma spraying, for example, low pressure chamber, several stabilized torches, vacum arc-spraying unit and so on. It may consider that plasma spraying can be also assisted by other heat source such as laser beam, so called a hybrid plasma spraying unit operated by more than two heat sources. I want to ask you about this approach?
5. They are trying to put an after teatment of plasma spray coating by HIP, laser glazing and so on to improve the physical and mechanical characteristics of the coatings. Can we expect these techniques?
6. The applications of plasma spraying technique is rapidly growing these days to various fields. However its market is still limited. The market extension can be prevented by several problems, typical one of which are cost performance and quality of coating layer. How do you think of plasma spraying technique in future?

Answer (*Prof. H.D. Steffens*) :

1. There is a large variety of possible ceramic coating systems available, after years, however, till no Zirconia (partially stabilized) shows best overa properties. There are possible improvement in proces ing as well as possible selection in order to give bette adhesion to the base material and avoid crack fo mation in or paralled to the surface.
   I wonder whether there will be another ceramic syste to replace the Zirconia coatings in the near future. don't believe.
2. Problems in the application of sprayed coatings mainl arise due to inadequate coating properties and the lac of property control, so one of the most urgent develo ment should be that of easy-applicable methods o non-destructive testing. This coatings would no longe be unpredictable in behaviour under enhanced sever conditions in respect to adhesion, crack formatio existence of pore clusters etc. Another step is th development of equipment and material based o scientific investigation of processing and governin process parameters; away from the try-and-erro methods.

Composition and structure stability of ceramic coating ar of governing influence on coating performance and highl dependent on kind of applied production process an process parameters. Then different processes provide quit different conditions, for instance on temperature an velocity. With the high speed processes (like D-gun providing much lower particle temperatures than the usu plasma spray processes. In the future, the selection o process will no longer be subject of personal in intuitio but will have carefully to consider all these aspects i order to obtain optimum coating properties. I see two-way use of computers in thermal spraying, the firs being a means of control of process parameters. There i an obvious necessity for that and it is being done alread as may be seen in JWRI-labs. The other use will be withi an expect computer system where-on the base of dat bank information and special software-a proper design o coatings meeting service conditions best, may be carrie out.

"Formation of Ceramics Coating by Laser Proces ses"

Dr. M. Wehr

Question (*Dr. N. Yasunaga*) :

Laser surface modification technologies have not been s much adopted yet in practical production in spite of thei attractive features about which Dr. Wehr has presented This means that these new technologies should be muc more brought up to develop into future businesses. Al