"New Developments in Specialty Metals Processing – the Role of the Science Base"

Prof. J. Szekely

Question (*Prof. M. Ushio*) :
The paper includes the technological change and the need for technical innovation in the melting, refining and solidification processes. About them, some speakers will discuss later, together with that in the other field. Therefore, I will ask on the latter half of the paper.
In this paper the emphasis is placed on the importance of mathematical modelling of processes. As an example, the melting behavior has been discusses. In the field, the materials are treated as the continuum medium in which the characteristic resolution of size and time shall be given by collisional relaxation of constituent particles. However, in order to develop the mathematical model for plasma synthesis or solidification structure, I suppose, that the phenomenological model based on atomic level interaction will be necessary, in that case the process will be characterized by the more precise space-and time-scale. It might be called as computer simulation based on molecular kinetics or atomic physics.
This could give another view to the concept of mathematical modeling of process, which you have been developing intensely. If you have any comment on this point, please discuss on it.
In Japan, some researchers in the field of materials engineering don't believe the practical value of mathematical modelling. The reason is considered due to the inevitable assumptions or simplifications included in the modelling. In that situation we have to consider the concept of "good" modelling. Would you give us some comments on it?

Answer (*Prof. J. Szekely*) :
I thank prof. Ushio for his kind remarks. I agreed that the modelling of solid structures, including those of the atomic level, are key modelling tasks in the future. At MIT a program has been recently initiated, aimed at combining molecule dynamics with continuum transport modelling efforts.
As far as the importance of mathematical models is concerned, I had no doubts. I showed that mathematical models play a key role in providing an insight into a process. Just as much as a model is not helpful without experimental verification, experimental data will be useless unless there is a quantitative interpretation for them through a model. It is hard to imagine a materials science laboratory without an electron microscope, the same way process research will need mathematical modelling as a key tool.

Question (*Dr. Amada*) :
You presented that plasma spraying process is on a half way of S-curve between performance and effort. Up to the matured performance, what is remained works which should be done? In another words, what should we study or develop about plasma spraying technique in future?

Answer (*Prof. Szekely*) :
I think that a plasma spraying is a very interesting technology which started as almost totaly emperical exercise. I mean people got the old plasma gun, you fed a powder to it, you sprayed it on a surface and you tried various things until you got a coating.
Now this whole field in a past ten years and developed here the same much greater details from Prof. Steffan in this afternoon. Has it developed into a real science and the begining to understand what is happening in this prophecies and I think plasma spraying offers many very interesting opportunities, not only just to deposit a coating but also to produce built porch.
Now, I think that many opportunities here for research that arrange from an optimum design of the gun to do this, they will design this plasma gun is still very unperical to I think much better understanding us to what is happening in a detail us your building up the structures. I think that many opportunities for their research arranging from design of the gun how you introduced the powder to the details analysis how the powder deformed. I think many people have done a lot of work describing what is happening between the gas and particles that I think is easy part. I think but a gun design and a detailed analysis of what's happening as your forming structures would be probably the best opportunities.

Question (*Dr. L. Pawlowski*) :
In the plasma spraying process, there is no formation of the liquid film over the surface of plasma spraying coating. The prechiced parameters are choosen in the way that the particles arriving to the surface solidify very quickely without forming liquid coating. Could you please comment this point from the point of view of modelling of solidification in plasma spraying process?

Answer (*Prof. J. Szekely*) :
This is a nice opportunity to correct a possible misinterpretation. I was talking about ospray process. I was talking about number of spraying prophecies in plasma spraying I totaly agree with you that in principle at may

be possible but you definetely won't operate in a ragion by forming no liquid. In fact, we wrote a paper on this some years ago. For examples that I cited was in the Ospray or other droplett processes where you in fact and up operating regieme and I think the big difference is the thinckness of the coating, if you are putting down the thickness of few microns or few tens of microns, you can very easily get in regiene no liquid is formed. If you're actually putting down and much thicker layer maybe or milimeters or tens of milimeters than you'll have a liquid wall. But I'm glad you raise this and give on a chance to correct a possible misinterpretation.

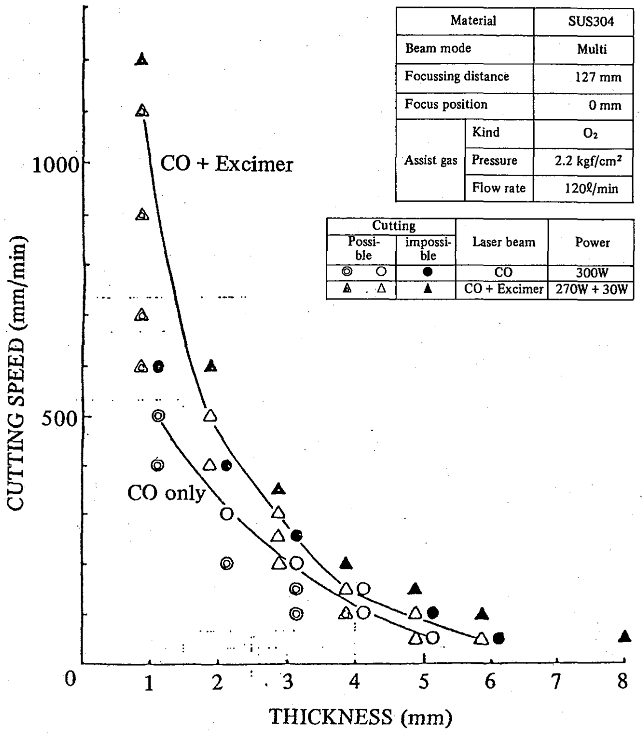
"Role of Lasers in Modern Materials Processing"

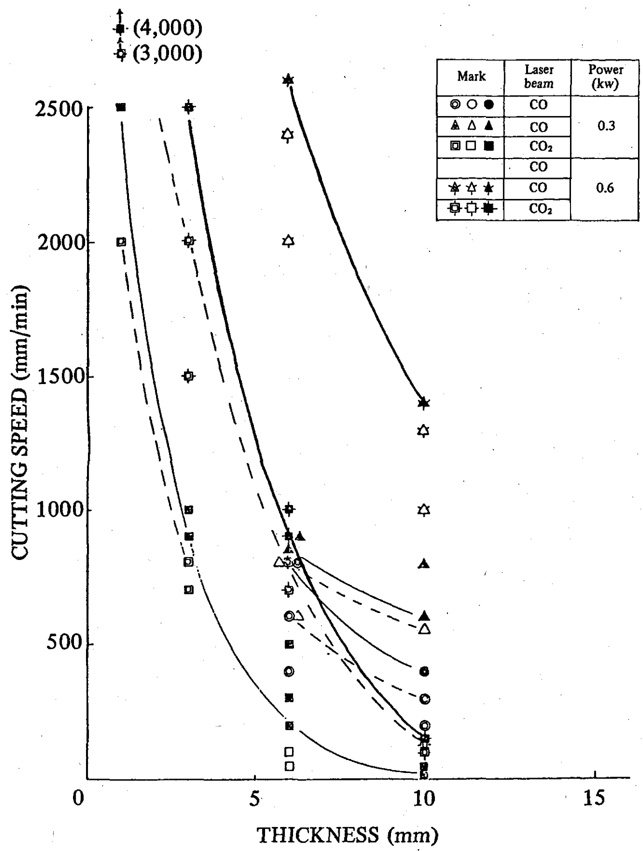
Dr. E.A. Metzbower

Comment (*Dr. T. Fujioka*) :

Up to now, CO_2 laser and YAG laser have solely been used for experiments on laser material processing, such as metal cutting, welding, etc. However, it is questionable whether or not the wavelengths of these two lasers are best suited for each of the ultimate purposes of applications. Particularly, 10.6 μm, the wavelength of CO_2 laser, is considered to be too long for many areas of application. Based on above thinking, we have been conducting experiments to develop other lasers than above, and also experiments using these new lasers.

In this conference, I will review the preliminary experimental results and the states of arts on the three lasers: CO laser, I laser, and excimer laser.





Question (*Dr. Wallach*) :

The development of lasers in material processing seems to follow those of electron beams in the field of, say, joining and cutting. Now electron beam process is used extensively in the semi-conductor industry i.e., for micro technology, and lasers also already have been used for microsurgery. Even though the wavelengths of the live techniques are very different, please would you comment on the possible use of lasers for microtechnology in materials science.

Answer (*Dr. Metzbower*) :

First of all, I have never had any experience in that area, but secondly I always have a view on something whether it is right or wrong. I think the problem that we are talking about is the problem of resolutional wave length. With the small resolution, on the small wavelength you can get with the electron beam. There's a lot of very "Nano-science" that can be done with an electron beam but car not be done or accomplished with the laser. On the other hand, we haven't been able to figure out how to use an electron beam to go in and do some of the surgical aspects laser can do. I think that lot of ways we're talking about complementaly and sometimes overlapping process. And I think this is a process you described for the most