FOURTH EUROPEAN ELECTRO-OPTICS CONFERENCE AND EXHIBITION
Session on High Power Laser Metalworking
- Utrecht - October 13, 1978 -

HIGH POWER LASER METALWORKING PROSPECTIVES

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1. Introduction

High power laser emerged from applied research with sufficient glamour for potential industrial application to attract attention and enthusiasm.
Appearance of new processes in manufacturing technology with high expectation is not new, in recent history. It has to be noted that not always such expectation has been realized or at least not as largely as promised. It might be interesting there fore,to examine few such cases, before looking at the future prospect of laser.
Take, for instance :

- electron beam
- adaptive numerical control
- robot

Electron beam has been used in aerospace engineering for ten years before starting sensible penetration in more conventional industrial mechanics.
Still one has the impression that the potentiality appeared larger than actual applications.
Electron beam has found its own niches in special

application in manufacturing processes.

Adaptive numerical control has not yet found large applications after more than a decade since commer cialization.
For the future, a larger diffusion can be seen when appropriate sensors and actuators will be available and when microprocessors will be as common as micro switches are today in manufacturing systems.

Robot on the contrary seems to diffuse at a much quic ker pace in the shop floor.
Still larger diffusion of robot has to be expected or could be forecasted if more "intelligence" could be given to them. This will happen, when with better and new sensors and actuators, robots will become mo re adaptive and responsive to such varying conditions as, for instance, in mechanical assembling.

* If the history of such brilliant candidates for manu facturing innovations is not as glamourous as fore- casted, what about laser?

Laser enthusiasts in the past few years had already to resist the cold shower of the high cost of the equipment and the poor reliability of the first gene ration products coming out from laboratory prototypes.
Expectation for large and diversified successes in in dustrial manufacturing application for high power la- ser will certainly not become true without large ef- forts in application research and laser system develp ment.
A too early direct transfer in the shop floor of the laser could turn initial enthusiasm into disillusion.

* After this introductory remarks you might understand why I accepted with some esitation to present you this introductory remarks to this Session on "High Power Laser Metalworking".

The reason for me to be here is not as a laser expert, for wich I have no title, but rather as being responsible - in my capability of managing a large corporate research center - to have launched a large and diversified R & D program for laser application.

To give an idea of the magnitude of the program, I could simply say that we are engaged in three different Laser Application Centers:

one in our Corporate Laboratories and two in joint-ventures, one in the United States and the other in Italy.

I will try to implement my duties to this audience commenting on the present state of this technique, as far as the conditions for a successfull industrial future is concerned. I will therefore not, try to trace the development history which led the laser to its present position.

My comments must of course be understood as the expression of a personal opinion.

2. <u>We might now try to enter into the exercise of forecasting high power laser diffusion in manufacturing application</u>

* Let us describe an optimistic future scenario in which the power laser is seen applied in several manufacturing processes.

The scenario could be described as follows:

"The laser high productivity rate, its flexi
"bility and versatility characteristics will
"make possible and rentable its use in manufac
"turing line also as a substitute for proces
"ses that to-day are carried out-of-line, or

— omissis —

TABLE 1 BASIC LASER PROCESSES WITH THEIR POSSIBLE ADVANTAGES

ADVANTAGES \ PROCESSES	CUTTING	WELDING	HARDENING	ALLOYING	CLADDING
OF QUALITY	• NEGLIGIBLE THERMAL EFFECTS • SMOOTH BORDERS • HIGH PRECISION • MINIMUM KERF WIDTH	• LITTLE DISTORSION • DEEP PENETRATION • HIGH PRECISION	• HIGH HARDNESS • LITTLE DISTORSION • EXACT DEPTH CONTROL • POSSIBILITY OF TREATING LIMITED ZONES • TREATING ZONES WITH DIFFICULT ACCESS	• INFINITE POSSIBILITIES OF COMBINATIONS • COMPATIBILITY OF PROPERTIES BETWEEN SURFACE ZONES AND BULK	• SUFFICIENT THICKNESSES • COMPACT LAYERS • HIGH FUSION TEMPERATURE OF THE LAYER ACHIEVABLE • COMPATIBILITY OF PROPERTIES OF THE LAYERS AND THE BULK
OF COST	• HIGH PRODUCTIVITY BY SPEED • A SINGLE LASER SOURCE CAN PERFORM VARIOUS PROCESSES • ELIMINATION OF FINISHING PROCESSES • TIME AND POWER SHARING ON THE SAME OR ON DIFFERENT SOURCES AND WORKING STATIONS (~ 100% TIME EFFICIENCY) • POSSIBILITY TO CREATE A LASER ENERGY NETWORK WITH DIFFERENT SOURCES AND MANY WORKING STATIONS • GREAT DISTANCE BETWEEN SOURCE AND SAMPLE WITHOUT ANY MECHANICAL CONTACT • FOLLOWS COMPLEX WORKING PATH'S • MATERIAL SAVINGS • ENERGY SAVINGS				