The 23rd Sagamore Army Materials Research Conference was held last week in upstate New York. The theme was Nondestructive Characterization of Materials, and the intent of this meeting was to approach the subject with a broad brush treatment, including historical aspects, the assessment of significant advances in each topic area, important new capabilities, and discussion of some exploratory techniques as contrasted with the generally more focused and in-depth studies that have been reported here at Asilomar.

Recognizing the proliferation of nondestructive meetings this year, we took care to have Don Thompson and Mike Buckley serve as part of our organizing committee. The meeting was subdivided into four sections that included x-ray or non-optical radiation based methods; sonic and ultrasonic techniques; optical methods, and a session called "other", involving both established methods, such as penetrants, and newer techniques, such as exo-electron emission.

In the brief time that I have, I would like to hit the high points as they impressed me. First, I was struck by the idea that the major advances in the nondestructive field seemed to fall into two major areas. These were instrumental advances, and secondly, application of new signal and data processing methods. These two are different from new phenomena which I, as a metallurgist, naturally think of as the area of opportunity.

Sometimes these two areas are connected in rather sophisticated ways, and sometimes in straightforward ways. An example was the work presented by Birks of NRL on compositional analysis by x-ray fluorescence. New techniques in this area allow rapid analysis for 20 to 30 elements at less than $10 a sample now with sensitivities in the ppm range for metals and alloys.

Similarly in the x-ray diffraction area, rotating anode instruments are able to provide up to 6 orders of magnitude enhanced intensity over what was available a few years ago, opening up new subjects for study such as kinetics of transformations, which in the past have been impractical because of the time considerations, and here we're talking about time factors which have now been reduced from hours or days to seconds.

In the extreme case, flash x-ray methods can provide detection of dynamic events on a scale of nanoseconds. And here again, there are great opportunities for looking at phenomena such as phase transformations that are diffusionless and other things of this sort.

Great advances have also been made in new solid state detectors. These were covered as well as image intensifiers. In this area, I was quite impressed by how close x-ray methods seem to be for fairly routine detection of residual stresses under field conditions using portable equipment, etc. And similarly, analysis of fatigue damage in fairly complicated hardware seems to be performed fairly routinely in Japan by x-ray methods.

Special capabilities of neutron radiography, e.g., detection of moisture and bond inspection (among other things) in composites and in honeycomb sections, were pointed out in an excellent review by one of our number here, Dr. Joseph John, of IRT.

I won't go into the sonic and ultrasonic methods at all since they're being covered in great depth and breadth at this meeting and were nicely treated at Sagamore by some of the speakers here, Bruce Thompson, Otto Buck and Tom Moran, among others, except to cite again by way of example of expanded instrumental capability, a random signal flaw detection system which provides a signal to noise ratio enhancement of 4 orders of magnitude greater than with conventional pulse echo techniques.

On the optical end of things, we heard of a new venture to optically detect acoustic emission waves. Some of you who are interested can talk to Professor Bob Green here who presented this work. Of course, this offers another attractive potential of a non-contacting detection system.

Two most interesting discussions in the optical area had to do with infrared techniques to perform such varied tasks as automated IR control of spot welding controlled to plus or minus one degree centigrade in the range of, say, 1,000°C of the meniscus of a crystal growing through the melt, and a water-cooled IR probe which measures the temperature of moving turbine blades within operating engines. I thought this was very important and highly exciting.

Advances in magnetic perturbation techniques hold promise now of providing reliable flaw signatures in cases of fatigue or fatigue-wear cracks in bearing systems, and significant progress was also reported in eddy current methods. For example, multi-frequency eddy current techniques for a simultaneous measurement of surface hardness and case depth in gears; the probing of cracks under fasteners in aircraft, and so on.

High frequency microwave techniques were posed as potentially useful for surface crack detection, again, a non-contacting method, in rotating systems such as in helicopter rotor sections.

Also, on the more speculative end of things, developments in positron annihilation and exo-electron emission were reviewed along with potential applications, the former being proposed to study such things as order/disorder phenomena and small levels of either surface or bulk damage (for example, from cold work), and the latter to study phenomena such as adsorption, oxidation, or wear, where the work function of the material is paramount.
New approaches in the penetrant area were discussed, including attempts to correlate crack detection efficiency with fluorescence absorption behavior, better ways to quantify performance and inspection specifications, for example, employing quantitative metallographic techniques and new statistical analytical methods.

Last, it was suggested that the NDI community might profit from taking a fresh look at physical phenomena from the standpoint of coupled effects; that is, if it should prove impractical to detect an event, for example, to measure a temperature optically, there may be several other ways to do so: electrically, magnetically, etc. depending upon the proportionality coefficients of various detector materials.

By and large we were worried at the beginning that the Sagamore conference would get lost in the background of all the others, but those of us who were there felt that it pretty much did accomplish what it set out to do. The proceedings volume should be out within the year, and for those of you who are interested, I can provide copies of extended abstracts.