DISCUSSION

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Tom Barry: Chained rules based on incomplete knowledge are dangerous. For example, the rule that (If T > 1000°C, then ceramic) is invalid if (gas = argon) because many of the transition metals and a host of alloys become usable at temperatures over 1000°C in neutral atmospheres or vacuum. An expert system developed for one purpose, and therefore based on a restricted set of information, will not necessarily adapt well to another field of research.

Robert Munro (author's response): It is important to distinguish between the process, chaining, and specific rules. The process is quite general, while the rules are quite dependent on the problem at hand. Indeed, it should be kept in mind that an expert system is valid only within its precise domain of definition. Ensuring a sufficient and valid set of rules is a major part of the development of an expert system. Once a set of rules is specified, it should then be considered standard operating procedure to test the expert system program to ensure that it performs as desired. One advantage of using an expert system shell program is that when the designed expert system yields an erroneous result, the rules can be traced so that the faulty logic can be identified and corrected.

Philip Sargent: Forward chaining algorithms available in commercial expert system shells are not all the same. Most algorithms have very poor scaling behaviour. They work well with small rule sets, but large numbers of rules make the systems run very, very slowly. The "RETE" algorithm is the one that works. It is built into OPS83 and other, more expensive, knowledge system workbenches.

Robert Munro (author's response): The comment is well worth noting. As we discuss in the text of the paper, the developer would be well advised to conduct performance trials with the shell before investing those all-too-dear project funds. It is always important to be sure that the right tool is being used for the current job. Recent reviews have indicated that there are now several commercial packages that perform well when there are less than or about 1000 rules in the system.

Malcolm Farmer: With respect to the selector expert system for advanced ceramics, have the parameters influencing performance included the effects of surface topography created by the manufacturing process, which may require grinding to the required dimensions? Is there, at present, an established source for appropriate, valid data which relate mechanical strength to the effect of grinding parameters?

Robert Munro (author's response): The Structural Ceramics Database has provisions for recording information on the processing and fabrication history of the material. However, this information is rarely reported. Information on the preparation of a specimen for testing is more often reported, and that information is included in the SCD. Currently, there is no established source of data relating grinding parameters to materials properties. A recent article by P A Janeway (Ceramic Industry, May 1991, pp 18-21) discusses a

number of issues regarding the machining of ceramics.

Bill Lees: It is important to present critical issues in an expert system, even if the system cannot cope well. In this way the point will not be lost and may be commented upon by a human expert.

Robert Munro (author's response): An expert system for materials selection should always be designed to alert the user about unusual conditions that might require capabilities outside its normal operation. For example the value of a property such as thermal conductivity might change considerably after exposure of a material to an oxidizing environment at high temperature. If the application involves such conditions, the expert system should advise the user of the need for special measurement conditions and should issue warnings to the user when appropriate data are not available.