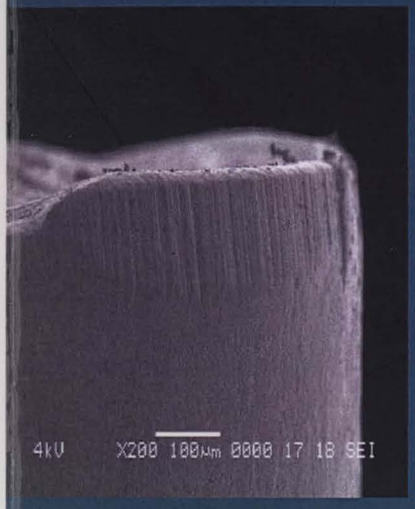

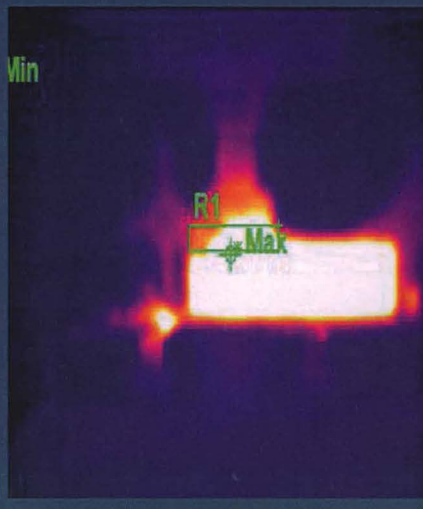

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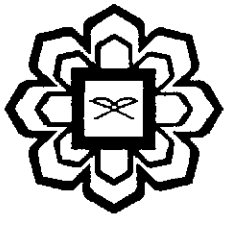

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Chapter 22

Microwave Sintering of Ceramic Materials

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1. Introduction

Microwave heating is different from conventional heating because the heat is generated internally during microwave heating, while heat is generated externally in conventional heating. The electrical and magnetic properties of a material being heated determine whether microwave radiation is reflected, absorbed or transmitted. Most materials transmit and/or absorb microwaves to varying degrees. Many ceramics are transparent or poor absorbers of microwave energy but when heated to a critical temperature, they become good microwave absorbers [1]. The Microwave Research Group at the Materials Research Institute of the Pennsylvania State University was the first to demonstrate very rapid sintering in time intervals varying from 3-20 min on many traditional and advanced ceramic materials such as alumina, mullite and hydroxyapatite [2, 3].

2. The Microwave Sintering of Ceramic Materials

It is well known that microwaves are widely used in many industrial applications including meat processing, pharmaceutical products and vulcanization of rubber. However, in the case of ceramic processing, microwave energy has been used since the late 1940's with a big push later in the 1980's. The application of microwaves has been limited, but not restricted to process control, drying of ceramic sanitary wares, calcination, decomposition of gaseous species and the sintering of oxide ceramics by microwave plasma [4]. Microwave processing of ceramics is fast emerging as a new field of ceramic processing and material synthesis. In recent years there has been significant progress in the aspect of commercialization and application of the technology to new areas. The most significant developments have been the use of microwaves in the sintering of non-oxides, such as tungsten carbide-based components and powdered metals, the fabrication of transparent ceramics and the design of continuous microwave systems [4].