Chapter 4
Conclusions

The control of the high-temperature mechanical properties of silicon nitride ceramics is explained in this book.

The fabrication of silicon nitride nanoceramics and improving their plasticity at high temperatures were described in Chap. 2. The fabrication of a nanopowder and its consolidation without grain growth are key factors in the fabrication of silicon nitride nanoceramics with high plasticity. Silicon nitride ceramics have good mechanical properties even at room temperature. If plastic forming is applied to production, the production cost is expected to be lowered.

The fabrication of heat-resistant silicon nitride ceramics is described in Chap. 3. Controlling the type and amount of sintering additives is important for sintering and for ensuring the heat resistance of silicon nitride ceramics. Evaluation of the heat resistance is also discussed in the chapter. High-temperature strength is one of the indices of heat resistance, but to determine the heat resistance, not only the high-temperature strength but also the deformation before elastic or inelastic fracture is required. Inelastic deformation before fracture suggests plastic or creep deformation. The measurement of high-temperature creep is also needed for the evaluation of heat resistance.

The studies described in this book were conducted at the National Institute for Materials Science (NIMS). The National Institute for Research in Inorganic Materials, which was merged with the National Research Institute for Metals to form NIMS in 2001, had a long history of research on non-oxide structural ceramics.

Application of silicon nitrde ceramics at high-temperatures are still limited under the present conditions. Oxidation is one of problems for applying to gas turbine components. When the silicon nitride components are used for gas turbine, an increasing of operating temperature will be expected, which means increasing of efficiency. We need a variety of energy generation systems with high efficiency as an alternative energy source of nuclear energy. Pure silicon carbide ceramics are used as a jig for silicon semiconductor production and indispensable for the purpose. Aluminum nitride ceramics are used for a substrate of high power device, e.g.

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in a hybrid vehicle. Stronger substrate with high thermal conductivity is needed recently, increasing of out-put of power-devices. Silicon nitride is a candidate. Non-oxide ceramics are used in an important part of our daily life and support our convenient societies.

We, NIMS, are conducting research on non-oxide ceramics, hoping to contribute to the further development of our life.