

## 学位論文及び審査結果の要旨

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学位論文題目 **Effect of chemical properties of healing agent on self-healing ability of oxidation induced self-healing ceramics**  
(酸化誘起型自己治癒セラミックスの自己治癒性に及ぼす治癒発現物質の化学的特性の影響)

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## 論文及び審査結果の要旨

The present study clarifies the correlation between the chemical reaction of healing agents and mechanical strength recovery of oxidation induced self-healing ceramics. Based on the obtained results, material design strategy for oxidation induced self-healing ceramics is established by using the new indicator of healing available temperature region. This thesis contains six chapters and abstracts of each chapters are described below.

Chapter 1 clearly describes the impacts of the study on both scientific and engineering aspects. In order to bring the study to a wider scientific context, the self-healing ceramics proposed earlier are organized by following research and development of self-healing material. The current issue in the field of self-healing ceramics is extracted from those discussions, and the purpose of the study is described.

Chapter 2 deals with the methodology for evaluating lower limit temperature of healing temperature region,  $T_{H-low}$ . The methodology has been established from the quantitatively evaluation of the relationship between oxidation behavior of healing agents and strength recovery behavior of self-healing ceramics.

Chapter 3 shows the design strategy for customizing healing agent is proposed from the discussion on the effect of cation in healing agent on the self-healing behavior. The effect is clarified through the experiment on strength recovery behavior and micro structural observation of alumina/ TiC composite. The strength of the material recovers to their original state by annealing at 800 °C within only 1h. On the other hand, excess outward diffusion of Ti cation is observed at relatively higher temperature: 1000 °C. This results indicates that the cation could enhance the oxidation activity of healing agent.

Chapter 4 deals with the methodology for evaluating upper limit temperature of healing temperature region,  $T_{H-high}$ . In this chapter, it is shown that self-healing ability has been disappeared at internal oxidation through the strength recovery test on alumina/ SiC composite aged at 1200 °C for 1000 h. This indicates the lifetime of self-healing ability can be evaluated as a function of growth rate of internal oxidation layer. Based on the result, the methodology for evaluating upper limit temperature of healing temperature region,  $T_{H-high}$ , is proposed.

Chapter 5 deals with the effect of interface condition between matrix and crack-filling oxide on strength recovery behavior of self-healing ceramics. The effect is discussed based on the results of strength recovery test of alumina/ TiC composite as a function of annealing time. The obtained results imply the formation of intermediate compound at crack-healed area plays an important role in order to achieve a desirable bonding of the interface between matrix and formed oxide, which results in the complete strength recovery of self-healing ceramics.

Chapter 6 concludes the present study and offers suggestion for the further research. Throughout the present study, the fundamental design strategy for oxidation induced self-healing ceramics is established.

上記論文要旨のとおり、本論文では自己治癒セラミックスの実用化に向けて必要不可欠な自己治癒エージェントの設計指針を明確にしており、博士（工学）の学位論文として適切であると判定した。