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STRENGTH AND MICROSTRUCTURE OF HYDROXAPATITE CERAMICS

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ในงานวิจัยนี้เราทำการตรวจสอบบทบาทของโครงสร้างจุลภาคที่มีต่อสมบัติความแข็งแรงของเซรามิกไฮดรอกซีอะพาไทต์ การตรวจสอบแบ่งออกเป็นสองส่วน ในส่วนแรกเราเตรียมเซรามิกไฮดรอกซีอะพาไทต์เฟสเดียวและหาลักษณะเฉพาะตัว ผลที่ได้จากเทคนิคอินเดนเทชันบ่งชี้ว่าความต้านทานการแตกหักของเซรามิกไฮดรอกซีอะพาไทต์เฟสเดียวมีค่าเดียวโดยมีค่าเท่ากับ 0.9 ± 0.1 MPam$^{\frac{1}{2}}$ และเซรามิกไฮดรอกซีอะพาไทต์มีความไวสูงต่อการเสื่อมความแข็งแรงและการสึกกร่อนที่จะเกิดขึ้นภายหลังในระหว่างการใช้งาน

ในส่วนที่สอง เรากระจายเตตระโกนอลเซอร์โคเนียที่มีอิทเทรียอยู่ 3 โมลเปอร์เซ็นต์ ลงในไฮดรอกซีอะพาไทต์อย่างสม่ำเสมอในอัตราส่วนปริมาตร 20 ต่อ 80 ผลที่ได้จากเทคนิคอินเดนเทชันบ่งชี้ว่าอิทเทรีย-เซอร์โคเนียที่กระจายลงไป ทำให้สมบัติความแข็งแรงและการสึกกร่อนของเซรามิกไฮดรอกซีอะพาไทต์ดีขึ้น คอมโพสิตเซอร์โคเนีย-ไฮดรอกซีอะพาไทต์ที่เตรียมได้มีความต้านทานต่อการสึกกร่อนสูงกว่าเซรามิกไฮดรอกซีอะพาไทต์เฟสเดียวมาก ความแข็งแรงมีค่าสูงกว่าเซรามิกไฮดรอกซีอะพาไทต์เฟสเดียวในช่วงของรอยร้าวขนาดใหญ่ ถึงแม้ว่าจะมีค่าต่ำกว่าในช่วงของรอยร้าวขนาดเล็กก็ตาม ยิ่งไปกว่านั้นความแข็งแรงของคอมโพสิตเซอร์โคเนีย-ไฮดรอกซีอะพาไทต์ไม่ขึ้นกับขนาดรอยร้าว การที่ความแข็งแรงไม่ขึ้นกับรอยร้าวนี้เป็นสมบัติที่พึงปรารถนาในแง่ของความเชื่อถือได้ในระหว่างการใช้งาน เพราะทำให้สามารถออกแบบความเค้นกระทำที่มีค่าเดียวได้โดยไม่ต้องคำนึงถึงขนาดรอยร้าว

ภาควิชา ฟิสิกส์ ลายมือชื่อนิสิต .....

สาขาวิชา ฟิสิกส์ ลายมือชื่ออาจารย์ที่ปรึกษา .....

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An investigation into the role of microstructure in determining strength properties of hydroxyapatite ceramics has been carried out. The investigation consists of two parts. In the first part, monophase hydroxyapatite ceramics has been prepared and characterized. The results obtained from the indentation technique indicate that the monophase hydroxyapatite ceramics has a single-value fracture toughness with the value of 0.9 ± 0.1 $MPam^{\frac{1}{2}}$ and is highly susceptible to subsequent in-service strength degradations and wears.

In the second part, tetragonal zirconia containing 3 mol% yttria has been uniformly dispersed into hydroxyapatite, using the volume ratio of 20:80. The results obtained from the indentation technique indicate that the incorporation of yttria zirconia improves strength and wear properties of hydroxyapatite ceramics. The prepared zirconia-hydroxyapatite composite shows a much greater resistance to wear than the monophase hydroxyapatite ceramics. Its strength are also found to be significantly higher in the large-crack size domain, although this is offset by lower strengths in the small-crack size domain. Moreover, its strengths are independent of crack size. Such crack-insensitive strength is a desirable property in the context of in-service reliability, because a single, well-defined design stress level can be made without regard to the size of a crack.

ภาควิชา ฟิสิกส์ ลายมือชื่อนิสิต .....

สาขาวิชา ฟิสิกส์ ลายมือชื่ออาจารย์ที่ปรึกษา .....

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