Nanosilica reinforced-composites Al/SiO_2 as anti-corrosion materials at high temperatures



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Backgraound

In geothermal exploitation, besides water steam, the contaminants such as sulfur, vanadium, sodium, etc. are also emitted as by-products, which can react at high temperatures with air and water forming *molten salts* which may probably accelerate corrosion. Therefore, for high temperature applications, materials having mechanical strength, high resistance to corrosion and oxidation are absolutely necessary (Sudiro, 2010). The focus of this research is to fabricate aluminum matrix composites with nanosilica reinforcers to provide anti-corrosion materials especially for high temperature applications such as geothermal installation. Nano-silica particles will be synthesized from natural materials (quartz sands).

Methods and Materials

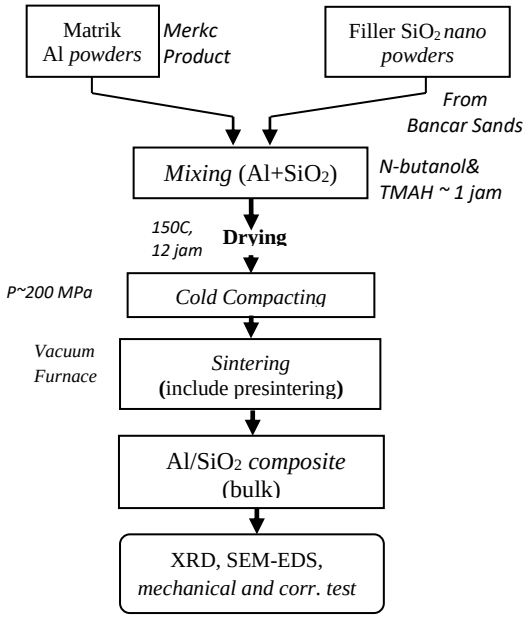

Figure 1 Fabrication process of Al/SiO_2 composite with powder metallurgy methode.

Result and Discusion

Fabrication of Al/SiO_2 composites with addition of N-butanol and tetra-metil ammonium hydroxide (TMAH) as active solutions, followed by sintering at 500 °C for 2 hours in vacuum furnace, has been successfully conducted using simple powder metallurgy approach. The major starting materials were commercial Al powders and extracted amorphous SiO_2 powders from Indonesian silica sands. The composites were comprehensively characterized by means of XRF, XRD, and SEM-EDS. Further characterizations in terms of physical, mechanical, and corrosion rate tests were also done. The addition of N-butanol into Al/SiO_2 (later abbreviated as Al/SiO_2(B)) leaded to broader. Beside Al, γ-Al_2O_3 crystal was also detected in the composites which was well confirmed by microstructural analysis. The unhomogenous distribution of SiO_2 with agglomeration characteristic within Al sheets was observed.

Introducing the amorphous SiO_2 into Al matrix decreased the density or increased the porosity of the composites. In addition, compression strength to reduce as the addition of SiO_2. The highest values of yield strength, compression strength and modulus of elasticity were observed in the composites with 5% SiO_2. In general, the corrosion rates in 1 M NaCl medium for Al/SiO_2(T) were lower than Al/SiO_2(B) composites. For comparison, corrosion rates of 1.6144 mm/y and 0.16936 mm/y were obtained by introducing 20% of SiO_2 into Al/SiO_2(B) and Al/SiO_2(T), respectively

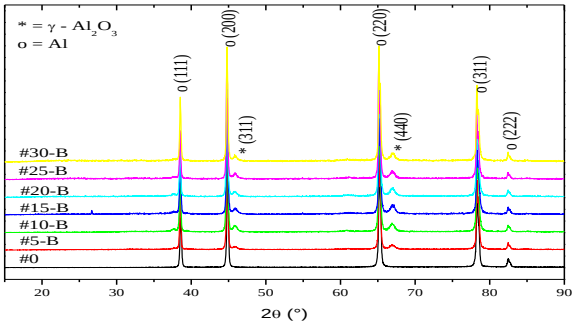

Figure 2 XRD pattern of Al/SiO_2 composite (Bulk) after sintering

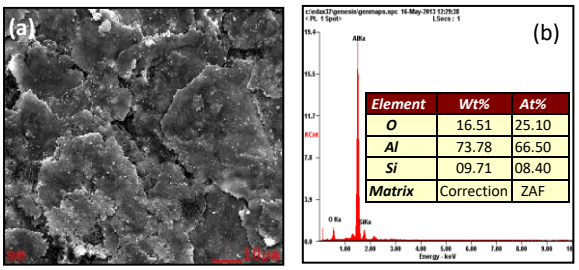

Figure 3.(a) SEM images, (b) EDX and element analysis of Al/SiO_2 composite (bulk) .

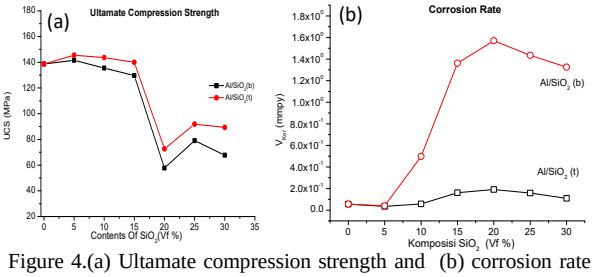

Figure 4.(a) Ultimate compression strength and (b) corrosion rate of Al/SiO_2 composite (bulk) .

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Reference

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