

# Pengaruh penambahan zirkonium dan lanthanum terhadap konduktivitas listrik dan ketahanan panas kawat konduktor aluminium

Gunawan, author

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## Abstrak

Pengaruh penambahan logam zirkonium (Zr) dan lanthanum (La) terhadap konduktivitas listrik dan ketahanan panas aluminium telah diteliti. Penelitian dilakukan terhadap tiga jenis cuplikan aluminium, yaitu aluminium kemurnian komersial (Cuplikan A), aluminium dengan tambahan Zr (Cuplikan B) serta aluminium dengan tambahan 0.04 % berat Zr dan La dengan kandungan La bervariasi (Cuplikan C). Cuplikan dibuat dengan proses penuangan dan pengerolan menjadi kawat berdiameter 3.52 mm. Konduktivitas listrik aluminium ditentukan dari pengukuran resistivitas listriknya menggunakan alat jembatan ganda Kelvin. Ketahanan panasnya ditentukan dari pengukuran kekuatan tarik cuplikan sebelum dan setelah pemanasan selama 1 jam pada temperatur bervariasi serta pengukuran kurva DSC (Differential Scanning Calorimetry). Untuk menjelaskan pengaruh penambahan unsur Zr dan La terhadap perubahan sifat aluminium, struktur mikro cuplikan juga diamati dengan mikroskop optik maupun elektron dan parameter kisi kristalnya dikonfirmasi dengan difraksi sinar-X.

Hasil penelitian menunjukkan bahwa penambahan 0.04% berat Zr meningkatkan ketahanan panas aluminium dari 85.1 % menjadi 91 %, tetapi menurunkan konduktivitas listriknya dari 61.78 % IACS (International Annealed Copper Standard) menjadi 60.07 % IACS. Dengan menambahkan lanthanum ke dalam aluminium yang mengandung 0.04 % berat Zr, konduktivitas listrik cuplikan B dapat ditingkatkan dari 60.07 menjadi 60.80 % IACS. Diperoleh indikasi kuat bahwa peningkatan ketahanan panas aluminium disebabkan oleh penghalusan butir dan terbentuknya fasa-fasa kedua di dalam aluminium, sedangkan peningkatan konduktivitas listrik disebabkan adanya penurunan kelarutan unsur-unsur pengotor di dalam logam aluminium akibat penambahan unsur lanthanum. Berdasarkan data penelitian ini, ketahanan panas dan konduktivitas listrik cuplikan aluminium yang optimum dapat diperoleh dengan penambahan 0.04 % berat Zr dan 0.13 % berat La.

.....A close study about the effects of the addition of zirconium (Zr) and lanthanum (La) metals on the conductivity and heat resistance of commercial purity aluminium has been carried out on the three kinds of aluminium samples consisting of commercial purity aluminium (Sample A), aluminium with the addition of Zr (Sample B), as well as aluminium with the addition of 0.04 wt % Zr and La (Sample C). The samples were made by casting and rolling processes to form a 3.52 mm wire in diameter. The electrical conductivity of the aluminium samples was determined by measuring the resistivity employing Kelvin double bridge instrument. The heat resistance properties were obtained by measuring their strength before and after heating the sample for one hour at various temperatures, and by measuring their DSC curves. To elucidate the effect of the addition of Zr and La to the properties of aluminium, their microstructures were also observed by the optical as well as electron microscopes and their lattice parameters were confirmed by X-ray diffraction. The results show that the addition of 0.04 wt.% Zr increased the heat resistance of aluminium from 85.1% to 91.0 %, however it reduces their electrical conductivity from 61.78 % IACS (International Annealed Copper Standard) to 60.07 % IACS. By the addition of La into aluminium containing 0.04 wt. % Zr, the

electrical conductivity of the Sample B can be increased from 60.07 IACS to 60.80 %IACS. There is a strong indication that the increase of the heat resistance was caused by grain refinement and the second phase formation in the aluminium, whereas the increase in the electrical conductivity of aluminium was caused by a decrease in the solid solubility of impurities in the aluminium due to the addition of lanthanum elements. Based on the data from such study, the optimum heat resistance and electrical conductivity were obtainable by the addition of 0.04 wt. % Zr and 0.13 wt. % La.