Comparison analysis of chemical composition in U-Zr-Nb alloy with using XRF and AAS technique

Masrukan

Nuclear Fuel Technology Center (PTBN)-BATAN
Puspiptek Area, Serpong, Tangerang Banten 15310
*Corresponding address : Masrukan2006@yahoo.com

Abstract

U-Zr-Nb alloy chemical composition analysis using X Ray Fluorescence (XRF) and Atomic Absorption Spectroscopy (AAS) techniques have been conducted, where U-Zr- Nb alloy was chosen as candidates for new high-density fuel for future research reactors. Composition analysis is necessary because the composition of elements in the fuel will determine the characteristics of fuel during the fabrication process and in the reactor. The use of two kinds of analysis techniques designed to obtain accurate analysis results. The experiment was conducted to determine the major element composition and impurities in the alloy U-Zr-Nb. First U-Zr-Nb varying alloy composition Zr respectively 1%, 4%, 7% (U10% Zr1% Nb, U10% Zr4% Nb and U10% 7% Nb) results of the melting process of measuring the diameter of 120 mm crushed on the surface bottom. Once on the bottom surface is smooth, then analyzed using XRF techniques. To analyze the elements using AAS techniques, alloy U-Zr-Nb cut into 10 mm x 5 mm then dissolved using HF and nitric acid. Solution that occurred were analyzed using AAS technique. From the analysis using the XRF technique is obtained for the alloy U-10% Zr-1% Nb, U-10% Zr-4% Nb and Zr-10% U-7% Nb) has a content of each element as follows: U (87.8858%), Zr (2.6097%) and Nb (0.2206%), U (87.8556%), Zr (2.6302%), and Nb (0.6573%); U (84.6334%), Zr (2.5773%), and Nb (1.0940) weight. Results of analysis using AAS techniques on samples obtained third consecutive Zr content of 9.25%, 8.90% and 9.80% while the content of Nb was not detected. Meanwhile, the results of elemental analysis of impurities in all three samples showed that almost all the elements are still qualify as fuel except Zn element. Element Zn in the three samples of each alloys U-10% Zr-1% Nb, U-10% Zr-4% Nb and U-10% Zr-7%Nb is 1.3266%, 3.2756% and 1.0927% weight. It can be concluded that the results of analysis of elemental content and impurities in the alloy U-Nb-Zr using both visible results of the analysis technique which is nearer to that planned to make the alloy U-Nb-Zr is by using AAS technique.

Keyword : Composition analysis, U-Zr-Nb, XRF, and AAS.

Introduction

The development of the fuel of the research reactor was aimed to get the new fuel that had the high density so that the amount of uranium (U) that could be loaded in the fuel to more of each unit of volum. The Centre of Nuclear Fuel Technology (PTBN) BATAN that had the task of developing the new fuel to replace the available fuel, where at the moment was developing several fuel sorts that are U-Mo, U-N and U-Zr. The development of the fuel of U-Mo was not yet still taking place and getting results in a manner the final. Because of that was developed the other fuel the kind of U-Zr and U-N.

The development of fuel U-Zr alloys by adding Nb was meant to improve the characteristics of this fuel especially the characteristics of endurance of corrosion. Bruno, et al carried out the use research of U-Zr-Nb alloys as the fuel of the research reactor by making the of U-4%Zr-1%Nb alloys and using the cladding that was made from the zirkaloi-4 alloys (Bruno et al., 2007). In the Nb increase of 1.5 % in the U-5% Zr alloy could be quench to got the structure of alpha phase that through bored where in this condition the U-Zr-Nb alloy had medium corrosion. The increase in the Nb element reached 7% heavy that it quench produced gamma phase metastabil in the room temperature, where in the gamma condition that metastabil the of U-Zr-Nb alloy had the rate of uniform corrosion very low (Kaufman, 1972).

In the production of the nuclear fuel, this fuel must have the content of the element of the very low polluter so as to fill the standard of the nuclear level (nuclear grade). Because of that the content of elements of the polluter must be in the nuclear fuel known definitely both the kind and the amount because of could disrupt the reaction between the fuel and the neutron during was used in the reactor. Elements of the polluter who accompanied the nuclear material including being: Cu, Cd, Fe, Mn, Mg, Li, Cr, Ni, and Zn (Kaufman, 1972). The existence of elements of the polluter that exceeded from the specification that was determined could reduce the quality from this nuclear fuel. For example the Cd element that had the high...