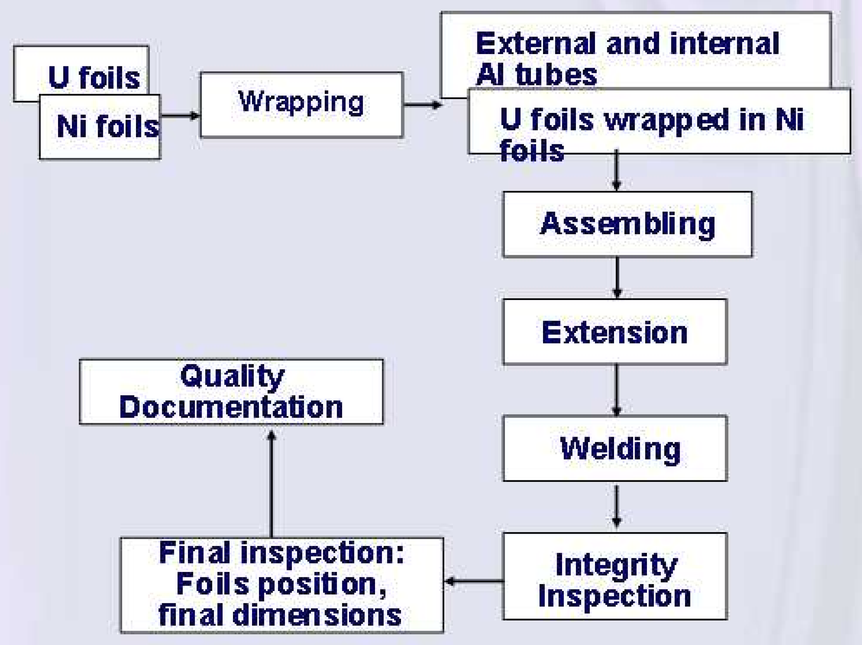
Alternative Fabrication Method of U Polycrystalline Foils for Mo-99 Irradiation Target

Ki-Hwan Kim(khkim2@kaeri.re.kr), Myung-Koon Son, Seok-Jin Oh, Don-Bae Lee, Byung-Chul Lee, Chang-Kyu Kim

Development of Key Technology for Fission Mo Production, Korea Atomic Energy Research Institute

Introduction

- RERTR program has performed R&D to produce fission isotope ^{99}Mo using LEU, the parent nuclide of ^{99m}Tc, which is a major isotope for medical diagnosis.
- Fissile part of ^{99}Mo irradiation target is a thin (100~150 μm thick) uranium foil sandwiched between inner and outer Al tubes.



- As uranium foils have been fabricated at a laboratory scale by repetitive hot-rolling method having significant problems in foil quality, productivity and economic efficiency, attention has shifted to the development of new technology.
- Under these circumstances, an alternative fabrication method of uranium foils has been investigated using a cooling-roll casting method in KAERI, in order to produce a fission product ^{99}Mo, the parent nuclide of ^{99m}Tc.

Experimental Procedure

Conventional Method

Melting/Casting → Cutting → Hot Rolling →

Heat−treatment → Washing → Foils

Alternative Method

Melting → Cooling−roll Casting → Foils

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Fabrication of apparatus

- Degassing system for U melt
- Discharge control of U melt
- Modification of collection chamber
- Heating system for cooling roll

Adjustment of process parameters

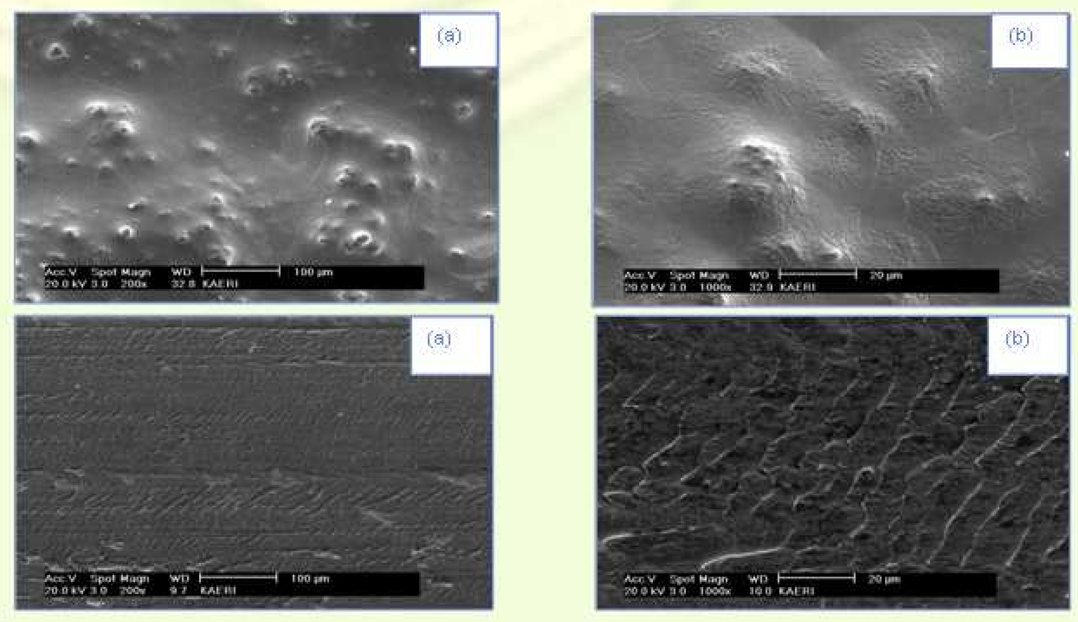
- Superheating of U melt
- Revolution speed of cooling roll
- Injection pressure of U melt

Results and Discussion

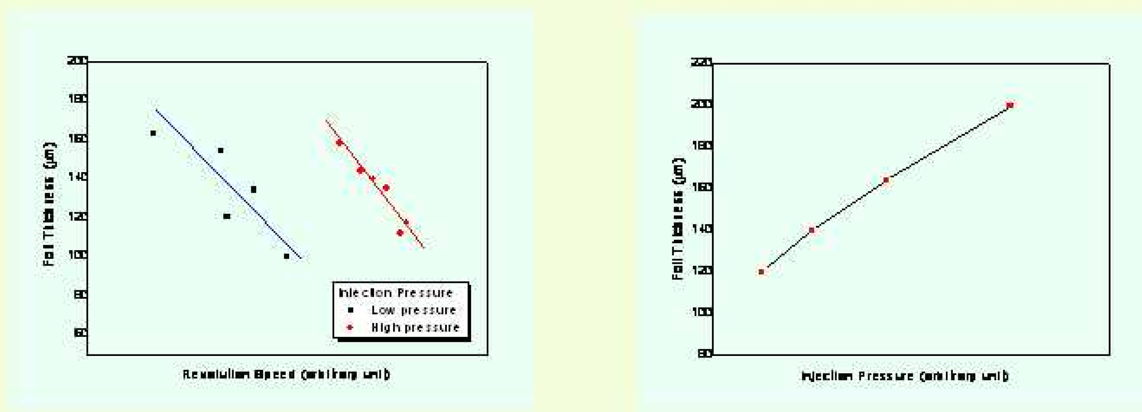
- 100 ~ 150 ㎛ in thickness and ~50mm in width, cast uniformly and continuously
- As the uranium has a low thermal conductivity, the collection apparatus was extended to fabricate the uranium foils without great defects soundly.

DU foil LEU foil

- Good surface state and very small holes of U foils fabricated by injection control and preheating of cooling-roll

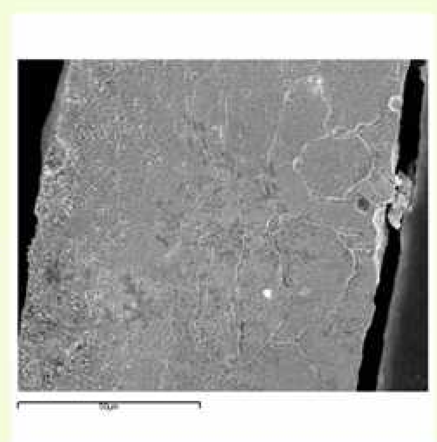


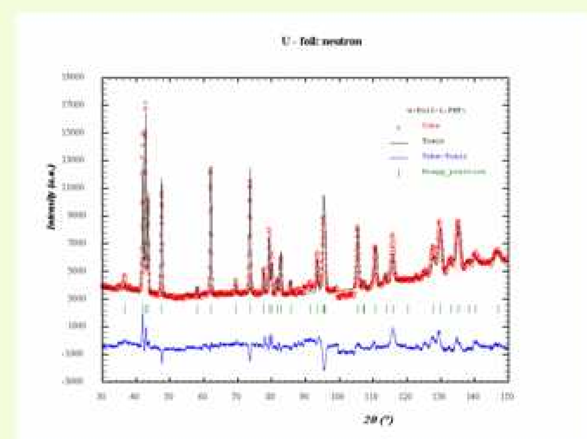
Scanning electron micrographs; free surface (upper) and wheel-side surface (lower), (a) x200, (b) x1000



Effect of the revolution speed and the injection speed on thickness of U foils.

Wheel-side surface





- LEU foil showed a difference in grain size according to location of the foil with fine grains below 30 microns in size with α-U phase, irrespective of process parameters.

Proto-type ^{99}Mo target, fabricated by welding of Al tubes

Conclusions

- Continuous polycrystalline uranium foils with a thickness range of 100 to 150㎛ and a width of about 50 mm are fabricated with the high quality of uranium foils and the high economic efficiency of the foil, through the variations of the various process parameters.
- The dimension and the surface state of the uranium foils are mainly adjusted with the revolution speed of cooling roll and the ejection pressure of melt.
- The uranium foils have fine polycrystalline grains below about 30 microns in size, irrespective of process parameters. It is expected that fine grain microstructure prevents the uranium foils from excessive swelling by an-isotropic growth behavior during irradiation at research reactor.