Optical property of Lithium vapor evaporated in vacuum or cover-gas area

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Liquid metal lithium (Li) technology is widely used for next-generation nuclear eneragy equipment and scientific and medical devives. When liquid Li is used in these applications, Li vapor that is produced by heat and beam irradiation may cause a degradation of vacuum and the crrosion of the equipment. Thus, evaluation of the amount of Li vapor and its density is important for the design of the equipment. Although some equipment with liquid metal device is generally designed based on saturated vapor pressure curve, it is difficult to evaluate the temporal amount of liquid metal vapor density that fluctuated depending on various parameters. The present study is intended to develope a novel measurement method of liquid Li vapor using the optical absorption characteristics.

The experimental setup for optical absorption of Li vapor consists on an optical source, an optical receiver and a vauum chamber. A crucible is positioned to fuse the Li into the chamber. Solid Li was put in the crucible and was dissolved using the heater mounted on the crucible. After the Li vapor temperature is raised up to around 300 degree, the light intensity though the Li vapor was measured. Optical source employs the semiconductor laser with wavelenght in 670 nm. Transmitted light measures light intensity of each wavelength by spectroscope and photomultiplier. To estimate amount of Li vapor, the deposition rate was measured by quartz oscillator positoned above the crucible.

From the transmitted light intensity, it was found that Li vapor absorb light of wavelength in 670.8 nm. The absorbance of Li vapor increases with increasing the temperature above 350 degree. In addition, the deposition velocity of Li vapor that is measured using the quartz oscillator increases with increasing the temperature above 350 degree. As a result, molar absorbance coefficient of Li vapor was obtained.

We succeeded to develop the optical measurement of the amount of evaporation of liquid metal Li and obtained molar absorption coefficient for the first time in the world. The obtained value is expected to be widely used for a design of new device using Li and sodium because the method is applicable to vapor measurement of the similar material.