

## ortho-Positronium annihilation in Room Temperature Ionic Liquids

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Melting temperatures of Room Temperature Ionic Liquids (RTILs) are lower than 100°C. They have very unique properties, and they show many interesting phenomena. There are many new application for many different fields. One of them is the spent nuclear fuel reprocessing. Therefore the irradiation effects such as the research of excess electrons, for example the mechanism of solvation, is very important. Electron solvation is usually very fast process. According to the spur reaction model [1], positronium (Ps) formation in insulation materials are caused by the very fast, ~ps, reaction of a thermalized positron and one of excess electrons. Therefore, the positron annihilation method can be a strong tool to investigate fast reactions of excess electrons. It was initially the reason of the positron annihilation experiments for RTILs. Recently, it was reported that the Ps bubble in RTILs showed some phenomena that were very different from them observed in other molecular liquids. [2,3] Now the reason of these interesting phenomena is being understood. The structure caused by the ionic interaction between anions and cations can exist even at the higher temperatures than the melting temperatures. It was the reason why the oscillation of Ps bubble was observed at the temperatures near the melting temperatures in RTILs. The small temperature dependence of the Ps bubble size is also, probably, caused by this ionic structure. Therefore, we decided to investigate the temperature dependence of the Ps bubble size in wider temperature range, i.e. higher temperatures. The vertical positron beams installed at AIST is suitable apparatus to investigate RTILs, because it is possible to inject positrons from the side of liquid surface. We are discussing the results of the positron annihilation lifetime measurements performed by the AIST positron beam for RTILs.

### References

- [1] O. E. Mogensen, *Journal of Chemical Physics*. **60**, 3, 998 (1974).
- [2] T. Hirade, *ACTA PHYSICA POLONICA A* **132**, 1470 (2017).
- [3] T. Hirade, *AIP Conference Proceedings (ICPA-18)*, in press (2019).

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