Ag+ and H+ emission from sharp-edged glasses under non-vacuum atmosphere

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Abstract

Ion implantation is one effective method for surface modification of materials, and has been applied for various field including semiconductor industry and bio-technology. For example, proton (H+) implantation, so-called proton therapy, has recently used most often in the treatment of cancer, in which accelerated protons are irradiated directly to cancer cells. In general, discharge plasma (gas) or liquid (e.g. liquid gallium) has been utilized for an ion source. However, in these cases, side reactions (generation of radicals or various ions with different mass such as H2+ and H3+ etc.) are unavoidable. Also, ion (particle) accelerators are huge and expensive.

On the other hand, ion emission from solid electrolytes has also been considered. Hosono *et al.* showed that O- ions exist inside cages of 12CaO·7Al2O3 (C12A7) crystal, and they successfully observed O- ion emission from the C12A7 by applying a high voltage. In the emissions from solid electrolyte, one crucial aspect is its high ion conductivity, and ion emission current increases with increasing ion conductivity of electrolyte. Compared with gas and liquid ion sources, ion emission mechanism of such solid-emitter is simple and almost _˜100% of emitted ions are O- ion in the case for C12A7. Even through, a high vacuum (10-5 Pa or less) condition is usually required, and applications of ion implantations are thus still limited.

We have studied high ion conducting glasses and those applications for ion emission gun. One big advantage of glass is its good formability, and we anticipate such ion conducting glasses can be applied for an emitter of ionic gun since the strength of the electric field is concentrated around the tip of the sharp-edged glass emitter. In our method, a palm-sized ion emission gun around 10 cm in length can be successfully obtained. Here we show preparation and emission properties of Ag+ and H+ ions. Surprisingly, these ion emissions can be observed even at room temperature and non-vacuum atmosphere. Evidence and mechanism of the Ag+ and H+ emission, as well as the effective enhancement of cell adhesion are also presented.

Keywords: ion conductivity, emission, proton

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