Superhigh performance bioplastics having

deformable rigid backbones

Tatsuo KANEKO1,\*, naoki takaya2

1*Graduate School of Advanced Science and Technology, Japan Advanced Institute of Science and Technology (JAIST), Nomi, Ishikawa, 923-1292, Japan*

2*Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Ibaraki, 305-8572, Japan*

\*e-mail: kaneko@jaist.ac.jp

Keywords: cinnamate, high performance polyimide, surface energy, cell adhesion



**Figure 1**. Typical structure of bio-based polyimide prepared from microbiual aromatic amino acid

 Demand of high performance bio-based polymers has increased due to their excellent thermal, high chemical, good mechanical properties and environmental concerns. Conventional bio-based polymers have been derived from aliphatic polyesters and then the performances were very low and no remarkable functions were shown1. On the other hand, bio-based aromatic polyimides or polyamides cover one of the most vital classes of high performance polymers to be suitable for using as super-engineering plastics. Nevertheless, an aromatic diamine as one of the monomers has never been derived from microbes due to their incompatibility with microorganisms.2,3

Here we focused on bio-based super-engineering plastics of polyimides and polyamides derived from bioavailable aromatic diamines, which were photodimers of 4-aminocinnamic acid (4ACA) available from genetically-engineered *Escherichia coli*, and tetraacid. These polymers were processed into transparent films having high heat resistance (*T*g > 270 oC, *T*d10 : ca. 400 oC), owing to rigid backbones. Some of polyamides showed superhigh mechanical strength over 400 MPa keeping good transparency, and high strain energy density over 200 MJ/m3, based on the deformability of cyclobutanyl moiety. Low density was provided in the range of 1.18-1.38 g/cm3. Then the presence bio-plastics can hopefully contribute to the sustainable society establishment where high-performance and light-weight materials should be utilized.

**Acknowledgement** The researches were financially supported by ALCA project (5100270) of JST and Grant-in-Aid for Scientific Research (B) (15H03864) of MEXT, Japan.

**References**

1. T. Kaneko, et al., *Nature Mater*., 5(12), 996-970 (2006)
2. P. Suvannasara, T. Kaneko et al. *Macromolecules*, 47(5), 1586-1593 (2014)
3. S. Tateyama, T. Kaneko et al. *Macromolecules*, 49(9), 3336-3342 (2016)