



## Characterization of traditional coloring materials using ToF-SIMS

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In Asian countries, traditional lacquers have been used for thousands of years as surface coating materials to decorate and protect various materials such as wood, leather, cloth, paper, ceramics, and metal. Lacquers have also been widely employed as binding mediums to attach different parts of complex or artistic objects together. They can maintain highly valued properties, including beauty, gloss, and durability for a long period of time.

The three kinds of lacquer trees found in Asia are *Toxicodendron vernicifluum* in Korea, China and Japan, *Toxicodendron succedaneum* in Vietnam and Taiwan, and *Gluta usitata* in Myanmar and Thailand. The saps from these trees are composed of substituted catechol and phenol derivatives (60–70%), plant gum, glycoproteins, enzyme laccase, and water [1].

This paper provides identification of several molecular species of vegetal-source Asian lacquers with the aim of providing a methodology for application in the field of cultural heritage. ToF-SIMS and FT-IR were used to characterize Korean, Chinese, Japanese, Vietnamese and Myanmarese lacquers; avoiding time-consuming and destructive extraction processes. These ToF-SIMS results provided the structural characterization of a series of catechol derivatives [2]. The ToF-SIMS spectra of *T. vernicifluum* (Korea, China and Japan), *T. succedaneum* (Vietnam), and *Gluta usitata* (Myanmar) indicated a series of urushiol, laccol, and thitsiol repeat units, respectively, in the mass range of  $m/z$  0–2200.

We also evaluated the compositions of mixed lacquers, and blends of the two, using ToF-SIMS and compared with the results of Py-GC/MS and HPLC [3]. ToF-SIMS provided quantitative results for blended lacquers; provided structural information on polymeric lacquer films; and indicated the presence of dimers and trimers of mixed catechol derivatives. These quantitative methods will be useful for improving the physical properties of polymeric lacquer films, evaluating the lacquer quality in industry and historic conservation.

[1] Yang, J., Chen, N., Zhu, J., Cai, J., Deng, J., Pan, F., Gao, L., Jiang, Z., Shen, F., *Sci. Rep.* **2020**, *10*, 12867.

[2] J. Lee, S. Jung, T. Terlier, K.-B. Lee, Y. Lee, *Surf. Interface Anal.* **2018**, *50*, 696-704

[3] H. H. Yu, J.-A. Lim, S. W. Ham, K.-B. Lee, Y. Lee, *Polymers* **2021**, *97*, 13