Electron Microscopic Observation of the Mammoth Ivory

Chang-Hyun Park[1)], Im-Joo Rhyu[2)], Ji-Woong Kim[1)], and Chang-Sub Uhm[2)]
[1)]Electron Microscope Facility, [2)]Department of Anatomy,
Korea University College of Medicine, Seoul, 136-705 Korea

During the Aichi EXPO 2005, a head portion of a frozen mammoth was exhibited. Mammoth is an animal believed to have become extinct between 7,000 and 8,000 years ago. The mammoth exhibited at EXPO 2005 was excavated in Siberia during 2004. According to the official website of EXPO 2005, the exhibition was made possible through three stages of organizational effort. The first stage (August-September 2003) involves preliminary surveys and data collection in Russia. The second stage (May-September 2004) is when a mammoth will be excavated. The specimen was transported and a display area constructed at the EXPO 2005 venue in the third stage (October 2004-May 2005). In the fourth stage (March-September 2005) the mammoth was exhibited at EXPO 2005. It will be kept intact and passed on to the future after EXPO 2005 comes to an end. As it was a large mammal that coexisted with humans during the Ice Age, the mammoth is a precious inheritance of the Earth. Regrettably, though, a perfectly intact specimen has yet to be discovered.

The mammoth ivory used in this research was purchased at the EXPO exhibition site. It was a small piece of mammoth ivory, whose authenticity was certified by the Mammoth Excavation and Exhibition Organizing Committee.

The small part of the mammoth ivory was cut using a diamond saw, and prepared for scanning electron microscopy without further treatment. Also some fraction was decalcified and processed for transmission electron microscopy according to the routine procedure. Samples were observed either with S-4700 field emission SEM or H-7500 TEM.

The cut surface of mammoth ivory did not show any structural characters by scanning electron microscopy except for a hair-like fibrous structure attached to the surface and a mound similar to the osteocyte of the dry bone. However, the cracks and defects revealed some organized structures. The ivory matrix was consisted of alternating raft-like plates, which are composed of bundles of fibrous elements. The

fibrous bundles were present at roughly a right angle. The spaces between the bundles were filled with finer filamentous structures.

Transmission electron microscopy revealed the collagen bundles running at different directions. They were well-preserved and cross striations were clearly seen. Bundles of collagen fibers run at right angles and were connected by a mesh of finer filaments. Some destroyed bacteria were present in the space where cells seemed to be present.

A mammoth ivory kept frozen for 7,000 to 8,000 years were well preserved. Even though the detailed ultrastructure of the whole layer of the ivory was not observed, the ivory matrix was composed of alternating sheets of collagen fiber bundles interweaved by finer filaments. If possible, more detailed comparative study using preserved remains of mammoth and current mammals would reveal more information.

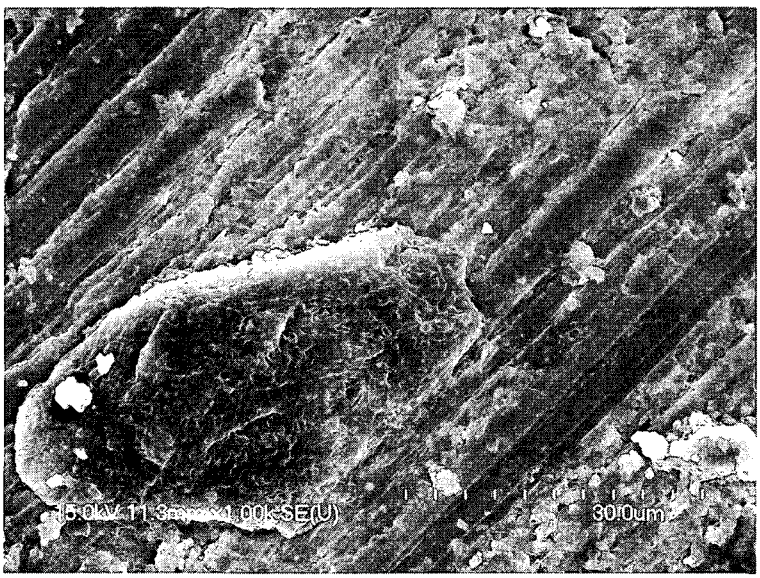

Fig. 1. Scanning electron micrograph showing the cut surface of mammoth ivory. Cell-like structure is present.

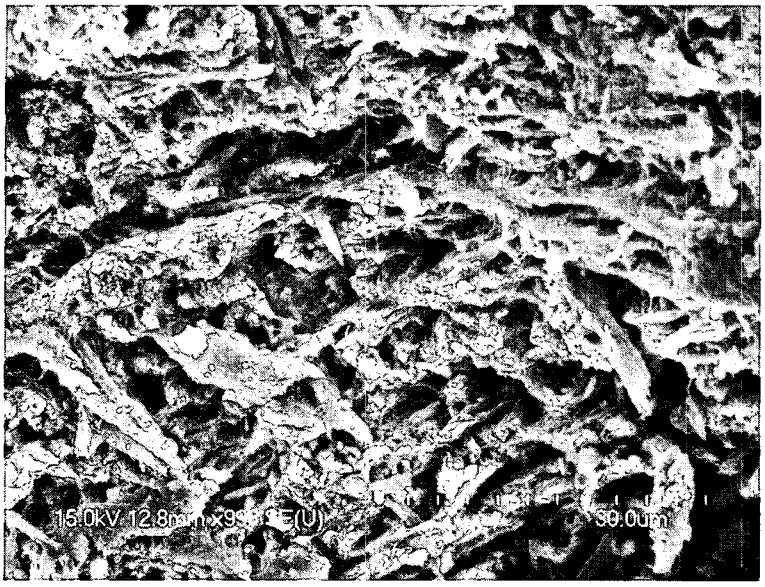

Fig. 2. A scanning electron micrograph of the mammoth ivory. The matrix is composed of alternating plates formed by fibrous bundles.

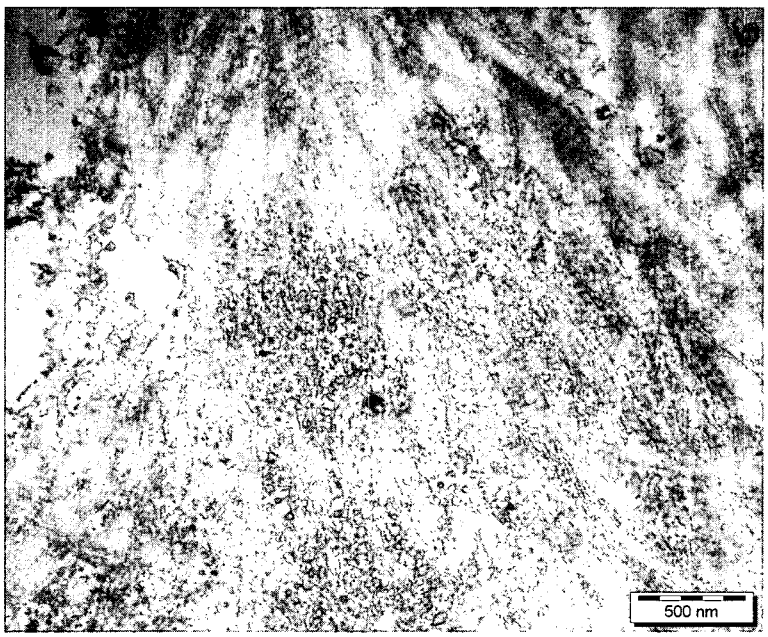

Fig. 3. A transmission electron micrograph showing the well-preserved collagen fiber bundles. The fiber bundles are running at right angles.