SHIMADZU
Excellence in Science

Application News

No.P100

Electron Probe Microanalyzer

Analysis of Biological Tissues Using the EPMA-8050G

Introduction

Biological tissues consist primarily of soft tissues and hard tissues. Bones, teeth and other hard tissues are formed primarily of calcium carbonate. In contrast, soft tissues are formed mainly of proteins. Metallic elements existing in biological soft tissues are strongly related to the growth (development) of these tissues. Understanding the concentrations and distributions of metallic elements plays a role in assessing developmental environments and states of health.

Human living and working environments contain naturally derived fine particles, as well as fine particles originating from work sites. Exposure to these particles sometimes brings the risk of impaired human health.

Here, we introduce an example of the analysis of biological tissues using the EPMA-8050G (FE-EPMA).

Cross Sections of Biological Tissues

Biological soft tissues are prone to destruction, deformation and other damage from the heat resulting from electron beam exposure. However, by using a special carbon stand (vitreous carbon with an average coarseness of approximately 3 nm), a biological tissue cross section approximately 2 µm thick can be closely affixed onto it without using adhesives. In this case, the heat from the electron beam penetrating the biological tissue cross section is absorbed by the carbon stand, so the damage to the samples is significantly reduced.

Fig. 1 shows the results of repeated analysis with the EPMA of cross sections of pathological tissue from the lungs of a person with a history of exposure to dust. There is virtually no damage to the biological tissue cross sections from exposure to the electron beam, so the same area can be analyzed repeatedly.

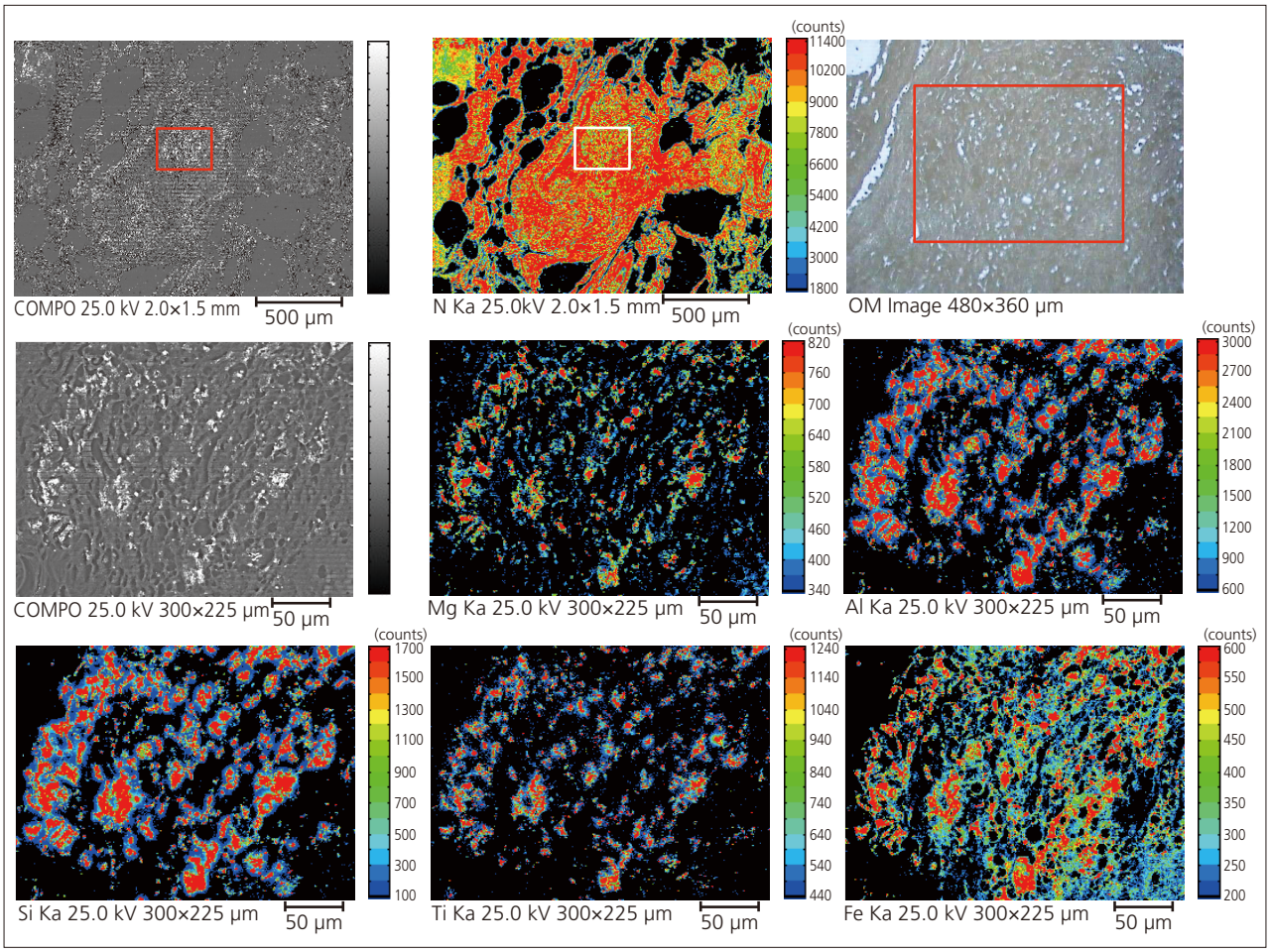

Fig. 1 Cross Sections of Pathological Lung Tissues

Toxicological Evaluation of Nanoparticles

When people breathe the air, they inhale fine particles of various sizes. Of the fine particles inhaled, those ranging in size from approximately 0.1 µm to 1 µm are not easily trapped by mucus, and are said to reach the alveoli of the lungs easily.

These fine particles appear as if they are aggregates approximately 10 µm in size wrapped in thin veils. The reason is said to be that rather than being captured and existing in the alveolar walls, they are subject to phagocytosis by the alveolar macrophages, and toxic compounds are then released to the surroundings during macrophage necrosis. In Fig. 2, an intracellular distribution of fine particles (Mg, Al, Si, Ti, and Fe) ranging in size from approximately 0.1 µm to 1 µm can be confirmed. In Fig. 3, it is also possible to confirm the existence of ultrafine particles (Fe) approximately 50 nm in size. The distribution of specific elements in the 1 µm range is expected to be of use in pathological clarification of toxicity related to the accumulation of fine particles (nanoparticles) of metallic elements.

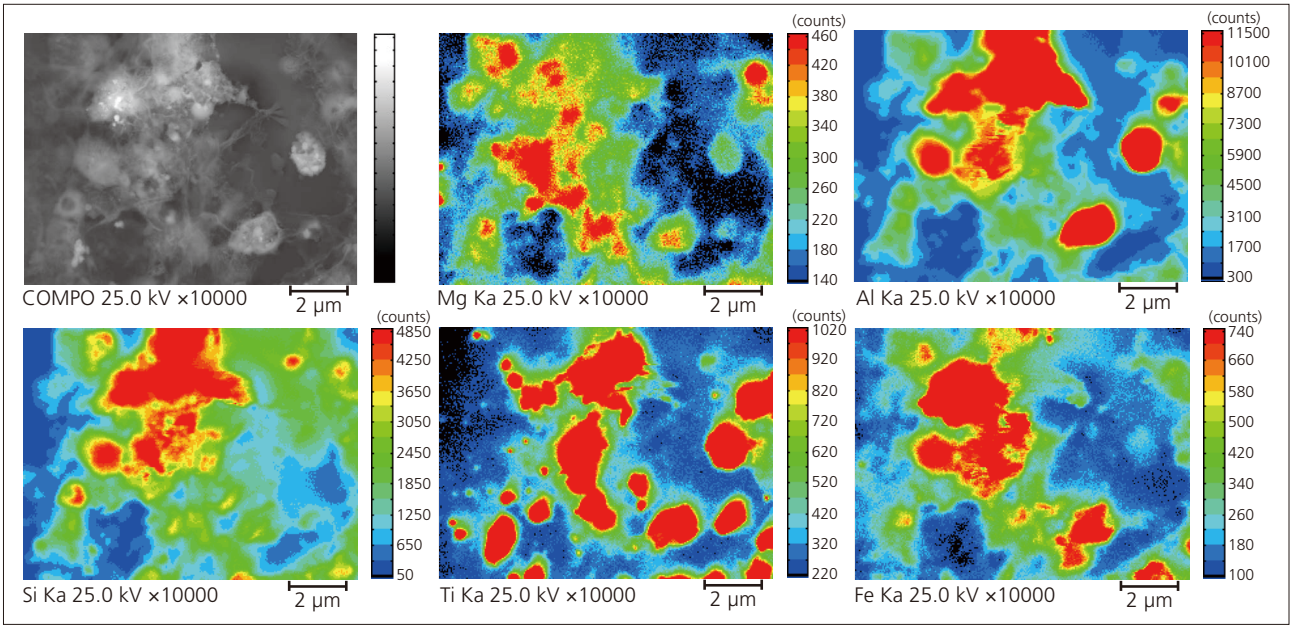

Fig. 2 Alveolar Macrophages

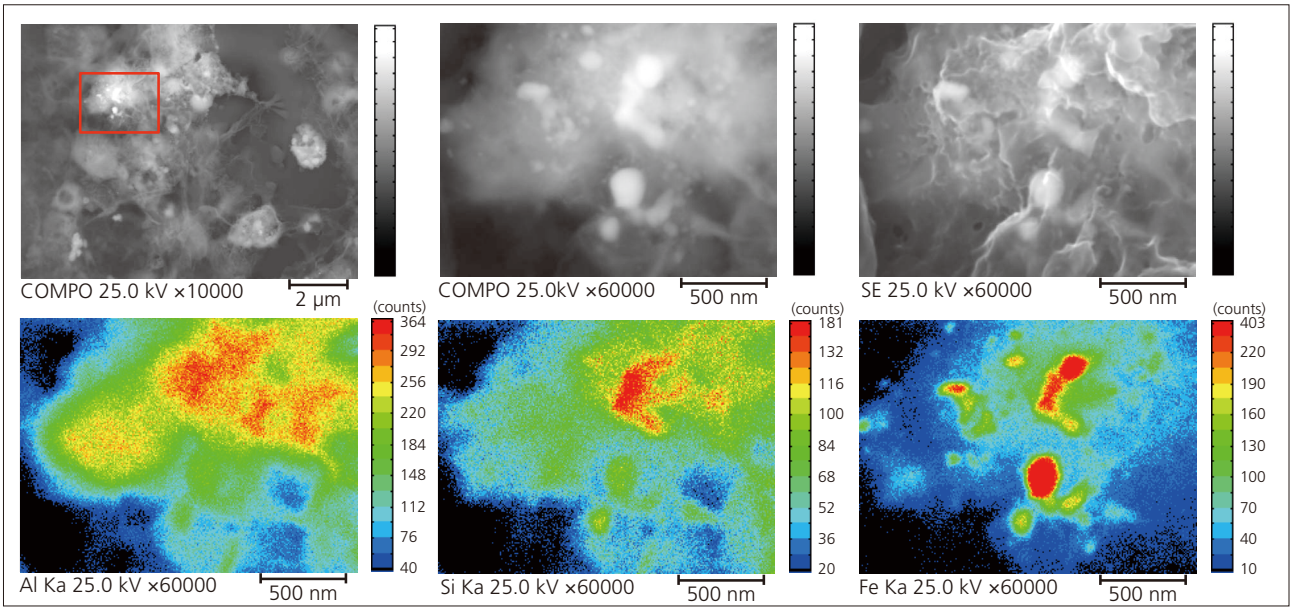

Fig. 3 Elemental Mapping of Nanoparticles

Samples Provided by: Center for Instrumental Analysis, Niigata University

First Edition: Apr. 2015

Shimadzu Corporation
www.shimadzu.com/an/