Report on a Special Investigation of the Shosoin Treasures: *Mushiro* —Techniques, Structures, and Materials of Woven *Mushiro* and Warp-twined *Komo* —

Junko Higashimura, Keiji Takabe, Fuminori Miyamoto,
Kakuyuki Mita, Yasuyuki Yamane, and Sadamu Shimogawa

This report summarizes the outcomes of the Special Investigation conducted by the Office of the Shosoin Treasure House in 2024, focusing on *mushiro* (plain-woven mats made from plant stalks) and *komo* (mats made from plant stalks using a warp-twining technique), which are included among the Shosoin Treasures.

The *mushiro* and *komo* preserved among the Shosoin Treasures hold an important position as ancient floor coverings; however, systematic examination of their production techniques, structures, and materials based on the actual artifacts has been insufficient. In this investigation, 11 representative treasures were examined in the repository, using a combination of visual and magnified observation, measurement of dimensions and weave density, photographic documentation, and microscopic analysis of fragment samples. This approach enabled the identification of production techniques, structures, and materials. Special attention was given to the technical distinctions between *mushiro*, as woven structure, and *komo*, as warp-twined structure, and the study sought to clarify and organize the characteristics of *mushiro* looms and warp-twining tools, as well as the structural differences of *meseki-ori* and *morome-ori* weaves among *mushiro*, the selection of materials in relation to techniques, and functional differences between *mushiro* and *komo* as products.

This report presents a foundational framework for understanding the position of *mushiro* and *komo* mats found among the Shosoin Treasures, serving as a preliminary step to future individual investigations.

Igusa Mats of the Horyuji Treasures and Horin-ji Temple

Kakuyuki Mita

In ancient Japanese temples, mats (including *igusa* mats and *tatami* mats) are thought to have been primarily used as bedding and seating for Buddhist monks. To understand their status and function, this paper first examines the *Horyu-ji Shizai Cho* (lit. Records of the Property of Horyu-ji Temple), compiled in Tempyo 19 (747).

The examination reveals that *igusa* mats and long *tatami* mats, which have *igusa* mats on their surfaces, were primarily employed as bedding, while *tatami* mats produced by cutting these long mats in half were likely used as seating. In addition, it is thought that woven plant mats made from cattail and nettle -related plants existed as less elaborate floor coverings compared to the *igusa*-based mats.

This study also provides an overview of extant examples of ancient *igusa* mats, including those in the Horyuji Treasures (currently housed in the Tokyo National Museum) and the one preserved at Horin-ji Temple in Nara. Among the Horyuji Treasures, examples of *igusa* mats can be identified: some were used as internal structural materials (cores) within floor coverings made of silk textiles, while others retained the original form of *igusa* mats. Distinctive examples are also identified in which patterns are created by weaving in straw or dyed *igusa* plant.

Finally, the study examines a *tatami* mat laid on the bed (Middle Section 202), preserved as a Shosoin Treasure and considered part of Emperor Shomu's personal belongings, and investigates its original dimensions as recorded in the Record of the *Kokka chimpō chō* (国家珍宝帳, List of treasures dedicated to Tōdai-ji temple on June 21st, 756). The findings indicate that the dimensions of this *tatami* mat share commonalities with the standards established based on the Buddhist monastic code.

Reproduction of the Armrest of *Nishiki* with Phoenix Design on Purple Ground

Shigeru Miyamoto

The Armrest of *Nishiki* with Phoenix Design on Purple Ground is one of the decorative art objects used as an interior furnishing and was cherished by Emperor Shomu. The *nishiki* with design of scrolling grape vine and phoenix on purple ground, used for the outer fabric of the armrest, was reproduced in 2003 to eventually replicate the armrest. In 2023, a reproduction of the armrest was completed using materials and techniques faithful to those of the Nara period, as detailed in this report.

The exterior of this artifact is covered with polychrome woven silk called *nishiki*, concealing its internal structure. By analyzing X-ray CT images of the original treasure, the materials, structure, and production techniques were clarified during the reproduction process.

The core of the armrest consists of stems of the *makomo* plant (*Zizania latifolia*), silk wadding, *igusa* mats, and ramie strings. For the reproduction, multiple prototypes were produced to accurately recreate each detail, including the bundling of *makomo* stems, the packing of silk wadding, and the use of *igusa* mats and ramie strings. Ultimately, by compressing the components with wooden molds and employing the blind stitch technique, a stable form and sufficient weight were achieved, allowing the reproduction to closely match the dimensions and appearance of the original treasure.

It is hoped that the reproduction will lead to a deeper understanding of the artisans'expertise and techniques of the period, as well as the context in which Emperor Shomu employed the artifact.

Comparing the Internal Structures of the Armrest of *Nishiki* with Phoenix Design on Purple Ground and the Armrest of *Nishiki* with Stripe Patterns Using X-Ray CT Scanning

Toshiyuki Torigoe

The Armrest of *Nishiki* with Phoenix Design on Purple Ground and the Armrest of *Nishiki* with Stripe Patterns, both preserved in the Shosoin, are listed together in the *Kokka chimpō chō* (国家珍宝帳, List of treasures dedicated to Tōdai-ji temple on June 21st, 756). Forming a pair of decorative art objects, they differ in appearance, dimensions, and fabric patterns, yet have been regarded as sharing the same intended use and function. On the other hand, because their internal structures could not be understood from external observation alone, their detailed internal construction had scarcely been examined.

In this study, X-ray CT scanning was conducted on the Armrest of *Nishiki* with Phoenix Design on Purple Ground (examined in 2015 at the Kyushu National Museum) and the Armrest of *Nishiki* with Stripe Patterns (examined in 2021 at the Nara National Museum), with the aim of understanding their internal structures without dismantling them.

The results revealed that both armrests share the same basic structure and crafting process. Each employs plant stems, likely *makomo* plant (*Zizania latifolia*), as core material; each has a recessed area at the center of the upper surface filled with a soft fibrous material thought to be silk wadding; and each is wrapped in an *igusa* mat and then covered with bast-fiber fabric and *nishiki* (polychrome woven silk).

These commonalities suggest that both armrests were likely produced in the Nara period within the same workshop or under related technical lineages. By contrast, structural differences believed to originate from the restoration in the Meiji period were also observed in the Armrest of *Nishiki* with Stripe Patterns.

The Combinations of Colors and Types of Pigments Used in *Ungen Zaishiki* Color Gradation as Seen in the Shosoin Treasures

Mami Tsuru

Ungen Zaishiki is one of the representative coloring techniques of the Nara period. It is characterized by the stepwise application of colors within the same color family without blending. In this study, 15 wooden artifacts decorated with *Ungen Zaishiki* were examined using macroscopic examination, near-infrared photography, X-ray diffraction analysis, X-ray fluorescence spectrometry, and visible reflectance spectroscopy to identify the colorants used. As a result, the colorants identified are as follows: For blue-toned *Ungen*: azurite, indigo, iron-containing blue pigment, lac, and hematite; For red-toned *Ungen*: minium, cinnabar, lac, hematite, yellow organic colorants, and *kindei* gold pigment; For green-toned *Ungen*: malachite, brown organic colorants, indigo, yellow organic colorants, *kindei* gold pigment, and hematite; For purple-toned *Ungen*: lac, *suo*, azurite, *gindei* silver pigment, and hematite. It was also confirmed that hydrocerussite, cotunnite, laurionite, and blixite were used as white colorants, and it was inferred that soot-based *sumi* pigment was employed as a black pigment in some areas.

Notably, the blue colorants used in the blue-toned *Ungen* fall into three types: azurite, indigo, and an iron-containing blue pigment, for which vivianite is a potential candidate. Previous studies assumed that azurite and indigo were used in ancient *Ungen Zaishiki* coloring, but the identification of an iron-containing blue pigment distinct from these two represents a noteworthy finding.

Lineage of *Kara-tōsu* (“Tang” Penknives)

Akihiko Nishikawa

Among the 67 penknives preserved in the Shosoin, three are longer than the others and exhibit a blade curvature known as *takenoko-zori* (“bamboo-shoot curvature”). It was hypothesized that, based not only on the formal characteristics of their blades and mountings but also on the distinctive qualities of their blades’ iron material, two of these three penknives were likely to correspond to the *Kara-tōsu* (“Tang” penknives) and the *Gilt bronze Kara-tōsu* recorded in the *Kokka chimpō chō* (国家珍宝帳, List of treasures dedicated to Tōdai-ji temple on June 21st, 756). Through this examination, and based on the observable characteristics of the materials used to decorate the scabbards, it was confirmed that none of them correspond to items listed in the *Kokka chimpō chō*. Although, one cannot completely rule out the possibility of a mistake on the list. Above all, common structural features were observed in these scabbards, and when considered alongside the distinctive iron composition of the blades, this led to the conclusion that these three pieces belong to the lineage of *Kara-tōsu* penknives.