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Traditional symmetries of Japan: Manji and kamon

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Manji, the Japanese Buddhist swastika symbol, forms a part of a typical Japanese *p*4gm pattern. Besides this 'parent' pattern, an interesting, affinely modified pgg variety and other derivatives are used. These form a subset of a family of swastika-meander patterns of classical Greek, Roman, Seldjuk, Ummayad and Buddhist art. In this vast body, families of 'rotation homologues' (*p*4 and *p*4gm, respectively), based either on 'normal' or 'recurving' swastikas or on their combination, as well as 'inclusion derivatives' which accommodate other elements besides swastikas, and other pattern types can be defined. A variety of swastika patterns was created by substituting the swastikas for squares, lozenges and triangles (as triskalions) of the Archimedean patterns. Plane groups with swastikas are altered into layer groups by assigning a 'spin' to each swastika. For example, p4gm alters into a layer group *p*4212. Kamon are heraldic symbols, originally used by aristocratic families, later also by commoners, guilds and temples. There can be one, three or five mon on a formal kimono. The medieval use of mon for friend-and-foe recognition in battles between clans is well known. The pictorial contents of kamon are rich: animals, plants, objects of everyday life and work, and pure geometric forms. Collections of kamon, such as that by Hondaso Ichiro (1992) show 2D point groups (from 16.m.m to 1) and layer groups, both of which show interesting variations derived skilfully from the symmetry of the object depicted, combinations of 2-3 different symmetries in one mon, as well as (projected) 3D groups and further motif varieties situated outside a point-group definition. As always in such cases, the statistics of the resulting symmetry groups is of great interest.

Keywords: traditional symmetry, manji (swastika), kamon (coat-of-arms)

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Self-similar ornaments obtained from girih tiles

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It has been discussed by various authors (Necipoglu, Makovicky, Bonner, Lu/Steinhardt) that islamic ornaments dating back as far as the 12th century possess geometric structures of the same type on different scale levels and thus give rise to self-similar patterns. A particularly intriguing example that gives insight into the construction of such ornaments is the pattern no. 28 of the Topkapi scroll. This sketch shows line ornaments on two different scale levels supplemented by additional lines indicating how the pattern can be constructed from a set of five girih tiles (i.e. tiles decorated with a line pattern constituting the overall line ornament). A close analysis of this pattern in the Topkapi scroll and of a portal at the Darb-i Imam Mosque in Esfahan showed that some of these tiles can be subdivided into smaller scaled versions of the same girih tiles. This raises the question whether these tiles give rise to genuine quasicrystal tilings via an iterated subdivision/inflation process. We demonstrate that a subset of three of these girih tiles (decagon, bowtie, elongated hexagon) indeed allow various inflation rules, even with different scaling factors and different possibilities for the symmetry properties of the subdivision. In contrast to the fairly large scaling factors (of approximately 5.2 and 8.5) found in the examples, we obtain subdivisions with scaling factor 2.6 which allow at least three iteration levels to be visible in an actual design. The non-periodicity of the resulting tilings is in all cases evident from the irrationality of the frequency ratios for the different tiles. Finally, we show that the by removing certain parts in the subdivision it is possible to produce fractals analogous to e.g. the Sierpinski triangle.

Keywords: girih tiles, self-similarity, quasicrystals

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Microstructure and formation process of reddish color pattern hidasuki on bizen stoneware

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Bizen stoneware, one of the famous artistic Japanese unglazed ceramics, has been loved for about 1,000 years because people perceive wabi and sabi from this stoneware. Here, wabi is a concept of the richness and beauty in simplicity and poverty, and sabi is an aesthetic sense of existing loneliness. The art is considered to be "an art of clay and flame " because the different colors appear in various forms without the aid of artificial glazing or dyeing figures. Fine control of these patterns is extremely difficult because multiple parameters such as the chemical composition of the clay, firing temperature, cooling rate, and effective oxygen partial pressure are involved. However, we believe that studies of the essential coloring mechanism from the viewpoint of solid state chemistry can provide artists with new inspiration and chemists with new concepts with respect to the creation of novel functional materials. In this study, we focus on a characteristic reddish pattern called Hidasuki appearing specifically where the clay contacts rice straw, which is used as a separator to prevent the adhesion of stoneware in the kiln. The reddish color on Hidasuki has been considered to be derived from hematite. We note here that the clay mined from the Bizen area in Okayama prefecture, Japan contains approximately 2-3 wt% of Fe_2O_3 and also that rice straw generates SiO_2 (84 wt%) and K_2O (13 wt%) when heated at 1273 K in air. A glassy phase forms through reactions of the clay with potassium provided by rice straw, in which small and red hematite crystals precipitate on cooling. Here, we report the evolution of a specific microstructure through model experiments.

Keywords: arts, stoneware, microstructure

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Symmetrical aspect of the Nabeshima ware

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The Nabeshima ware was Japanese porcelain produced in Arita,Saga Prefecture, under the feudal load of Nabeshima,in Edo period for some 200 years until 1871. The original form of it is Imari ware,exported to Europe. Since the Nabeshima ware was produced by a clan klin, it was not sold and used mainly as gift among shougun and feudal loads. The patterns are investigated by symmetry, chiefly in two dimensions using point group,plane group and color group. Some dishes show *16*, *8mm* symmetry, and Seikaiha *cm*, Shitihoutunagari *p4mm, c2mm* or *p6mm* and Bishamon *p31m*. Here one example of tri-color group is shown. It is Iroe bishamon-kikkou monnyou sara, Nabeshima, 17-18C. It is trigonal *p31m* as monocolor and tri-color *R3m* symmetry, derived by Belov et al.(1964 Shubnikov). In this conference, some photos and symmetrical aspect will be shown. I thank Toguri Museum of Art,Tokyo and Dr.Yumi Mori of it for giving photos and information of Nabeshima ware.

Keywords: symmetry, color group, plane gruop

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Periodic motives and crystallographic topics in contemporary art, design, and architecture

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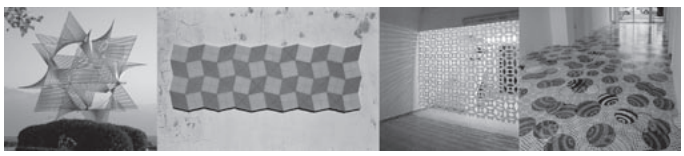
Since the beginning of humanity visual researchers, artists and scientists, are exploring symmetry and its applications. Today, after more than one century of separation, the relationships of the arts and the sciences are reconsidered, and fruitful collaborations are emerging. Today's scientific topics, methods, and tools are part of the artists' world, and the scientific community explores intensively art work, such as Islamic patterns or traditional textiles, too. Working as a visual artist and scientist, I wish to share with you my insight into both of these worlds. I will present aspects of contemporary artists, designers, and architects, related to crystallographic topics, such as 3D-periodic surfaces (Michael Burt, Peter Pearce, Angel Duarte, Marion Regitko), and the application of repetitive motives (Vreni Spieser, Rudolf Stingel, Samta Benyahia, Yinka Shonibare, Rahel Hegnauer, Samuel Fosso). Figures (left to right): Angel Duarte, E.4A. l. (Ouverture au monde), 1972-73, Lausanne, Switzerland. Rahel Hegnauer, Blau/Rosa, and Scherenschnitt, 2001, Rades, Tunesia. Vreni Spieser, installation, 2008, Berlin, Germany (Photographs: A. Zuern, R. Hegnauer and V. Spieser).



Keywords: art, design, architecture

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X-ray analysis of cultural heritage at museums by using portable instruments

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We have been developing a portable powder diffractometer and XRF spectrometer since 2001 jointly with two X-ray makers: i.e., Institute of X-ray Technologies Co. Ltd. and OURSTEX Co. Ltd., respectively. The instruments were brought to several museums as well as many archeological sites in Egypt, Turkey, Italy, etc. to characterize the cultural heritage and the results were reflected on their improvement. The instruments thus developed are suitable for on site analyses with enough sensitivity, accuracy, and durability. The latest version of our diffractometer (weight 15kg) adopted Si-PIN as a detector, which enable us to obtain EDX spectrum of the sample as well as a good powder diffraction pattern with low background. The XRF spectrometer (25kg) is equipped with SDD detector and monochromatic/white X-ray sources. Recently the Be window of the detector was replaced with MOXTEK AP3 polymer window and vacuum sample chamber was introduced to quantify Na and Mg. The instruments were brought to Archaeological Museum in Zadar, Croatia, Okayama Orient Museum and MIHO Museum in Japan. The samples are glass, pottery, metallic and stone objects dated from second millennium B.C. to modern. We have chemically characterized 109 Roman glass artifacts excavated at a Roman necropolis found in Zadar, and classified based on decolorants, impurity and vessel types. We have studied glass, faience, pottery and metal collections at the Orient Museum. The results include identification of cassiterite in glazed Islamic pottery. At MIHO museum, stone objects from China and Middle East were characterized by the diffractometer. The analyses were made as joint projects with S. Gluščević (Archaeological Museum), R. Shikaku (Orient Museum), Y. Azuma and Y. Kuwabara (MIHO Museum).

Keywords: nondestructive analysis, archaeometry, instrument development