# Analysis of mabe pearl characteristics of bead lining treatment

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**Keywords:** Mabe pearl; color substrate processing; identification.

**Abstract:** In recent years, various colors of Mabe pearls have appeared in the market, some of which are rare in seawater cultured pearls. In this paper, a purple Mabe pearl was collected for gemological routine testing and related test analysis. It was found that it was treated by beading and bead nucleus coloration, which was difficult to detect in routine identification detection. Infrared spectroscopy and X-ray fluorescence spectroscopy analysis considered it to be Seawater pearls, magnified observation and UV-vis spectral analysis are indicative of their color processing.

## 1. Introduction

Mabe Pearl is a semi-circular bead with a diameter of more than the general seawater pearl after the hollowed-out core of the seawater cultured beaded pearl is combined with the mother-of-pearl and the filling material. In recent years, some Mabe pearls have appeared in the market, which show less color in seawater cultured pearls and bring more artistic expression to jewelry production. However, in the conventional test, the general conclusion is that the color processing is not checked except for the flattening process, and the color authenticity is questioned, and its market share has an upward trend, which is interfering with the pearl consumer market. In this paper, the purple Mabe pearls collected in the market were selected as experimental subjects. The infrared spectrum analysis, X-ray fluorescence spectrometry and UV-visible spectrophotometer used in routine testing and conventional pearl identification were used to test and analyze. The identification of Mabe pearls provides relevant analytical data.

## 2. Sample gemological routine test

A total of 4 capsules of Mabe Pearl and similar colors of freshwater cultured pearls were collected from Zhejiang Zhuji Market. Among them, Mabe Pearl is a relatively rare pink-purple sample of common seawater pearls. This color is common in freshwater cultured pearls but seawater pearls. It is relatively rare, so four freshwater cultured pearls with very similar colors were selected as comparative samples.

Table 1 Basic conditions of the sample

| No. | Type | Weight(g) | Shape(length×width×height)(mm) | Color | Lustre |
|---|---|---|---|---|---|
| MP-1 | Mabe pearl | 1.835 | Heart shape cabochon(15.7×18.0×5.8) | Pinkish violet | Strong |
| CP-1 | Fresh water pearl | 0.609 | Bead (7.9×7.9×6.6) | Pinkish violet | Medium |
| CP-2 | Fresh water pearl | 0.661 | Bead(8.0×7.8×6.5) | Pinkish violet | Medium |
| CP-3 | Fresh water pearl | 0.627 | Bead(8.0×7.9×6.5) | Pinkish violet | Strong |
| CP-4 | Fresh water pearl | 0.650 | Bead(8.1×7.8×6.7) | Pinkish violet | Medium |

Magnified observation of MP-1 samples, the surface is smooth and smooth, the skin light is good,

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no obvious defects are observed, and the “contour line structure” which is not obvious on the surface can be seen. The contour line is more uniform and fine. The reflected light on the surface of the microscope was observed, and the color of the sample had an uneven patchy distribution.

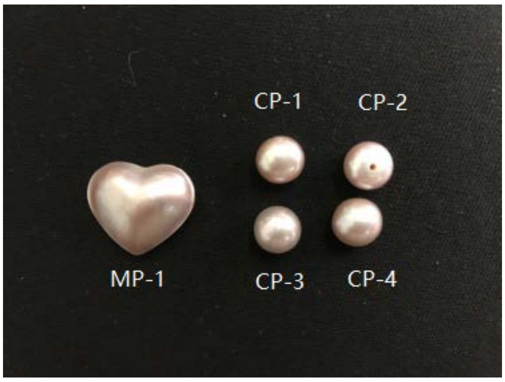


Figure 1 Basic situation of the sample

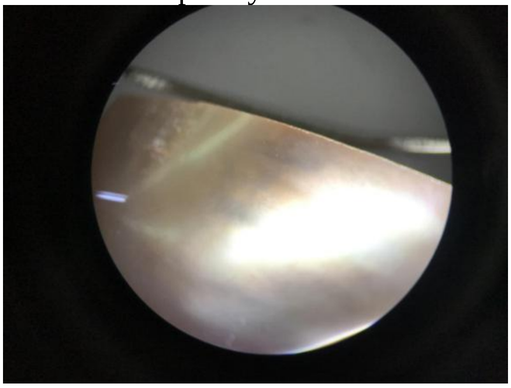

Figure 2 MP-1 color patchy (15×)

For further analysis, the MP-1 pink sample was cut and observed from the cross section. The Mabe pearls were presented in four layers, with the filling layer (the thickest part 3.4 mm), the color substrate layer and the bottom shell from the middle to the outside. Layer (about 1.1 mm) and top nacre (about 1.3 mm). The observation result is basically the same as that of the Mabe pearl. The shell is removed from the mother-of-pearl and the core is taken out, and the inside is filled with a resin material or the like, and the shell layer is laminated at the bottom. The pearl nacre is lavender, with a layer of colored material added between the nacre and the filling layer. The layer is evenly distributed between the nacre and the filling layer, and the color is positive red. Since the Mabe nacre is relatively thin (about 1.3 mm), this layer of color substrate can increase the color of the pearl through the nacre to achieve the purpose of “increasing color” for the Mabe pearl. Therefore, the appearance of the special color of the Mabe pearl is not caused by the dyeing, but the superposition of the substrate layer and the nacre layer leads to an increase in color saturation and a change in hue.

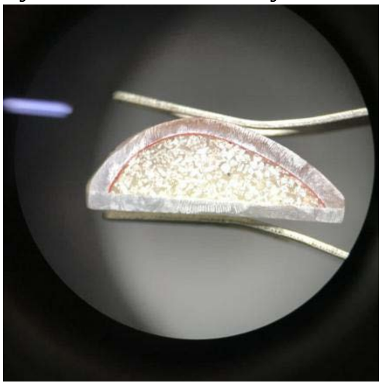

Figure 3 MP-1 cross section (15×)

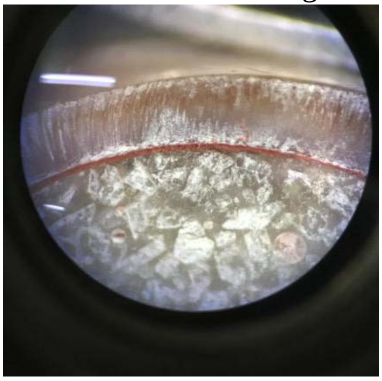

Figure 4 MP-1 cross section (45×)

### 3. Infrared spectroscopy

Infrared spectroscopy was performed using a Thermo Fisher Nicolet iS5 type Fourier transform infrared spectrometer. The direct reflection method was used to measure the scanning range from 400 to 4000 cm-1, the number of scanning times was 16 times, and the resolution was 4 cm-1.

After the infrared spectrum test of the sample, the peaks of all the pearl samples in the test sample were: high and gentle peaks around 1477-1485 cm-1, small and sharp peaks of 699 and 878 cm-1, and 1778 cm- The weak peak near 1 is close to the standard aragonite peak. In this test, the peaks of the two colors of freshwater pearl and Mabe pearl are basically the same. The peak of 1778cm-1 of freshwater pearl is slightly more obvious than that of Mabe pearl, which is the symmetric stretching vibration and in-plane bending vibration of $[CO_3]^{2-}$-ion. This conclusion is consistent with the fact that Li Liping speculated that [1] the ball in the freshwater pearl is related. The peak of the bottom layer of the Marbe pearl is basically the same as the peak of the nacre. The bottom is made of pearl motherfish. Therefore, the mineral composition is similar to the nacre, which is also the aragonite of the biological calcium.

All samples were tested multiple times from different directions, and no dye-related peaks were found. It can be seen that infrared can not be used as an identification basis for identifying whether pearls are color-treated.

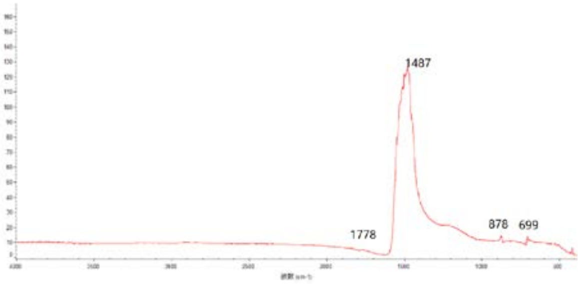


Figure 5 MP-1 powder purple Mabe pearl infrared reflection map

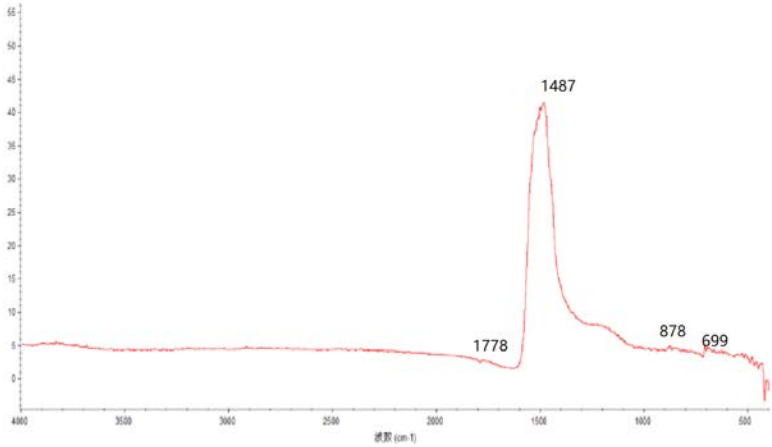


Figure 6 Infrared reflection of freshwater pearls

## 4. X fluorescence spectroscopy

The samples were tested by using the domestic Tianrui EDX300 energy dispersive X-ray fluorescence spectrometer. All samples were washed with water and dried before testing. In order to effectively distinguish the elements to be tested, the highest value of the main characteristic Ka peak of each element of the elements Ca, Sr, Mn is finally selected to record the element count value. The results are as follows:

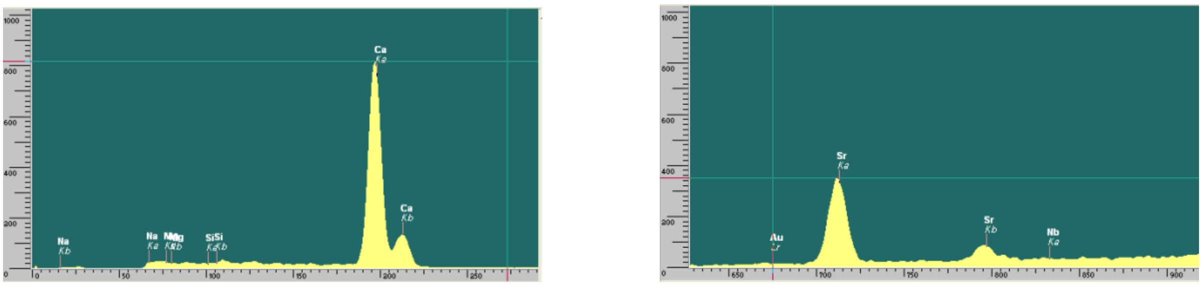


Figure 7 UV-visible spectrum of MP-1 powder purple mace pearl

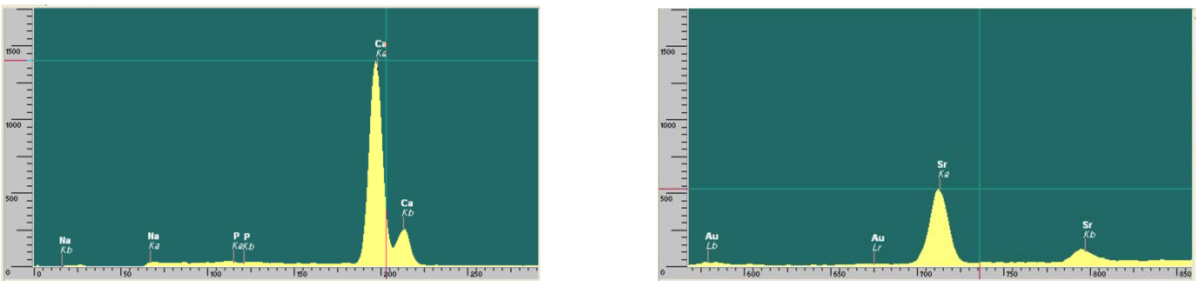

Figure 8 UV-1 Visible Spectrum of MP-1 Powder Purple Mabe Figure 2

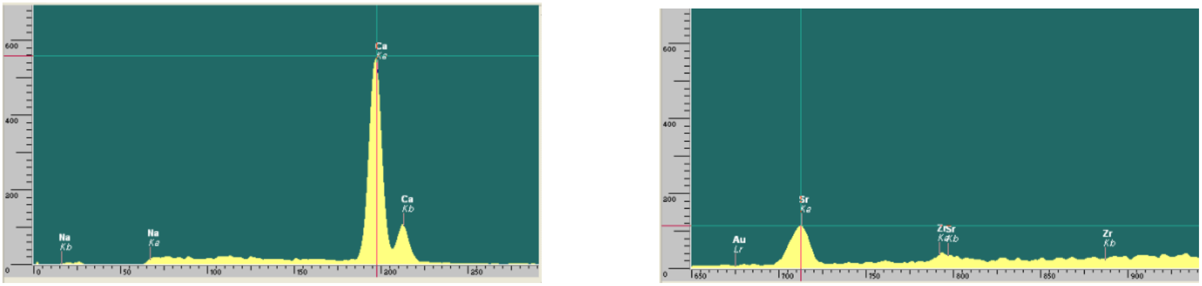

Figure 9 UV-visible spectrum of CP-1 freshwater pearl

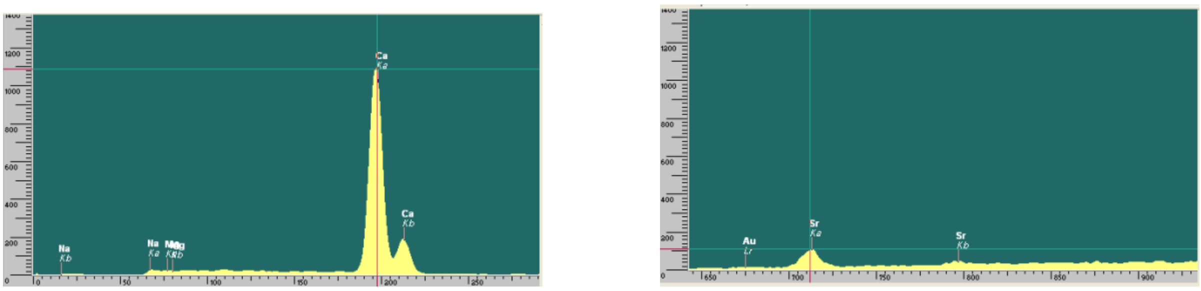

Figure 10 UV-visible spectrum of CP-2 freshwater pearl

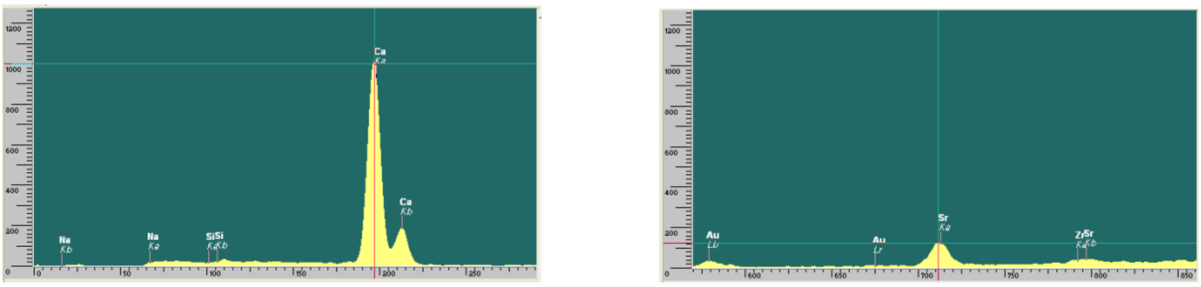

Figure 11 UV-visible spectrum of CP-3 freshwater pearl

In this paper, the peak intensity is counted, the Ka peak of Ca and Sr of the sample is counted, and the Sr/Ca value is calculated for comparison.

Table 2 Sample Sr/Ca count ratio

| No. | Type | Sr(Ka) | Ca(Ka) | Sr/Ca |
|---|---|---|---|---|
| MP-1 | Mabe pearl | 360 | 820 | 0.44 |
| MP-1 | Mabe peal | 550 | 1400 | 0.39 |
| CP-1 | Freshwater pearl | 120 | 560 | 0.21 |
| CP-2 | Freshwater pearl | 110 | 1080 | 0.10 |
| CP-3 | Freshwater pearl | 120 | 1000 | 0.12 |

The test results of all the samples show that all the pearls contain higher content of Ca and Sr, among which the content of Ca in freshwater pearls and Mabe pearls is higher, with very obvious peak, while the content of Sr content is obviously. Higher than freshwater pearls, the peak is obvious. Freshwater pearls did not detect significant Mn content, which is different from previous studies suggesting that Mn has a higher content, which is related to pearl color and instrument calibration. [1]

Through the calculation of Sr/Ca, the ratio of Sr/Ca of all Marbe pearls exceeds 30%, ranging between 30% and 44%, while the ratio of Sr/Ca of freshwater pearls does not exceed 30, ranging from 10% to 21%. %between. According to the previous analysis [2], the freshwater Sr/Ca ratio does not exceed 30% and the seawater pearl Sr/Ca ratio exceeds 30%, which confirms that the Marbe pearls collected in this paper are seawater pearls.

## 5. UV-visible spectrophotometer test

The surface of the bead layer of the pearl sample was tested by an ultraviolet-visible spectrophotometer GEM-3000 jewelry detector, and the results are shown in the figure.

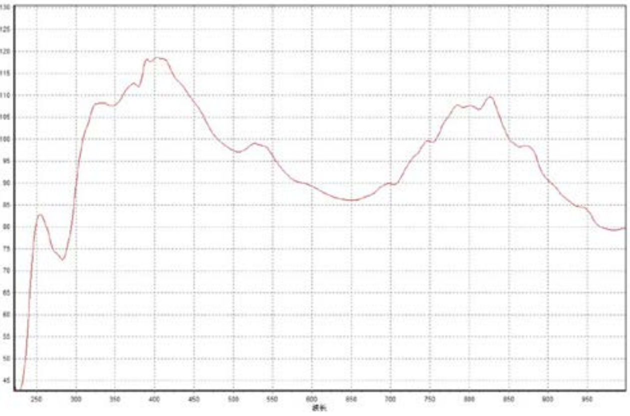

Figure 12 UV-visible spectrum of freshwater pearls

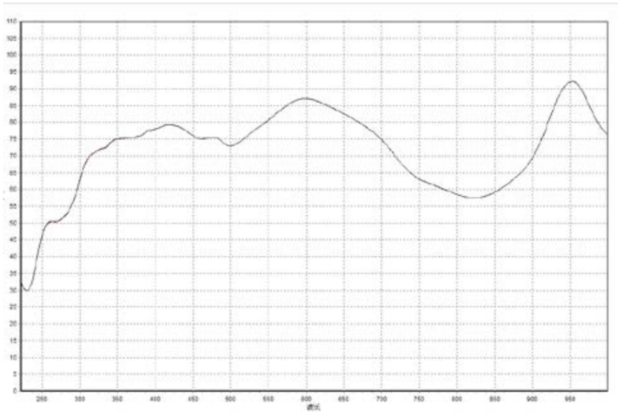

Figure 13 UV-visible spectrum of MP-1 Mabe pearl

After analysis of the results, all pearl samples, including Mabe pearls and freshwater pearls, have unique 240 nm and 280 nm absorption peaks. This result is consistent with the structural test of Yan et al. (2016). It is considered that the absorption peak at 280 nm is the peak in both fresh water and seawater pearls. The absorption peak should be derived from the organic matter that induces the mineralization of nacre aragonite. The aragonite plate inside the nacre has nothing to do with the quasi-one-dimensional photonic bandgap structure composed of organic matter.

Freshwater pink purple pearls show several small peaks at 350 nm, 380 nm, and 390 nm, a gentle absorption at 500 nm, and absorption at 650 nm. The pink-purple Mabe pearls also exhibited absorption at 340 nm, 380 nm, and 390 nm, and the absorption at 500 nm also existed with 460 absorption, and the absorption peak centered at 650 nm was absent. The freshwater pearls tested in this test can be traced to natural freshwater pearls, but there is no characteristic peak at 420nm related to porphyrin in previous studies. The absorption at 350nm, 380nm, 390nm and 500nm is considered to be related to the coloration cause, of which 500nm The peak is also present in the freshwater pink pearls in the test results of Severe et al. (2016) [3]. After comparing the pink-purple freshwater pearls with the pink-purple Mabe pearls, it was found that the MP-1 powder purple Mabe pearl samples had a weaker color-related peak than the freshwater pearls. In the test of freshwater pearl samples, it basically conforms to the law that the deeper the peak of the color is, the more obvious the color is. The color of the pink purple horse shell is darker than that observed by the naked eye. No peaks related to the dyeing cause are found in the test, but there are 340 nm, 380 nm, The absorption peaks at 390 nm and 500 nm are weaker than those of purple freshwater pearls. Since the test is limited to the surface layer, the color substrate layer under the Mabe nacre layer cannot be tested, so the Mabe pearl shows a peak intensity in the ultraviolet visible which does not match the actual color saturation, which can be used as a substrate for the Mabe pearl. One of the basis.

## 6. Conclusion

Through the detection and analysis of the collected samples, the special color Mabe pearls appearing in the market may be treated by the color between the nacre and the filling layer. It is difficult to detect in the conventional detection, and the samples are analyzed by infrared spectroscopy and X-ray fluorescence spectroscopy. It is shown as a seawater pearl, a special spectrum of unlined layer. In the magnified observation, the color is plaque-like, which is presumed to be caused by uneven pearl layer. The UV-visible spectrophotometer test did not find a special peak associated with the color-imparting layer, but the intensity of the relevant organic pigment peak showed that it did not match the actual observed color. It can be predicted that the pearl may be colored.

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