1. We know the relationship between Miller indices [hkl] and hexagonal Miller-Bravais indices [uvtw] are follows:

or

So, [100], [010], and [110] can be changed into [210], [120], and [110], respectively.

The transformation rules of crystal plane indices must be different, which is shown as follows:

Therefore, the plane (111) and (032) can be transferred into (111) and (032), respectively.

**How can we confirm these above?**

Firstly, we should figure out the three axes’ indices and [hkl] belong to the hexagonal axes.

In three axes, there are a1, a2 and z axes while the four axes system has one more a3 axis than three axes system, where the a1, a2, a3, and z are all vectors.

We can look at the **Figure 1**, a3 = a1 + a2, the four axes indices are [uvtw].

**a2**

**O**

**a3**

**a1**

**Figure 1**. Four axes system.

[uvtw] = u a1 + v a2 + t a3 + w z

= (u-t)a1 + (v-t)a2 + w z = h a1 + k a2 + l z

Therefore, ,

So we obtained or .

The relationship between (hkl) and (uvtw) is obvious, where the t is also equal to –(u+v).

2. We get the two-dimensional rectangular counterclockwise rotation matrix:

Where the is the angle of rotation.

On the other hand, the transformation of rectangular coordinate system to oblique coordinate system can be elucidated as **Figure 2**.

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**Figure 2**. The transformation from rectangular coordinate system to oblique coordinate system

Look at the **Figure 2**, the point (x, y) in rectangular system, and the corresponding point (, ) of oblique system. Therefore, the transformation matrix of rectangular system to oblique system is .

Finally, we can firstly rotate (x, y) 120 degrees, and secondly transform it into oblique system. This transformation matrix is .

Therefore, in the oblique system, the original point is , while the finally transformed point is

Therefore, the oblique transformation matrix is .

So, we get the transformation rules:

Moreover, the 4(00z) transformation matrix is

Therefore,