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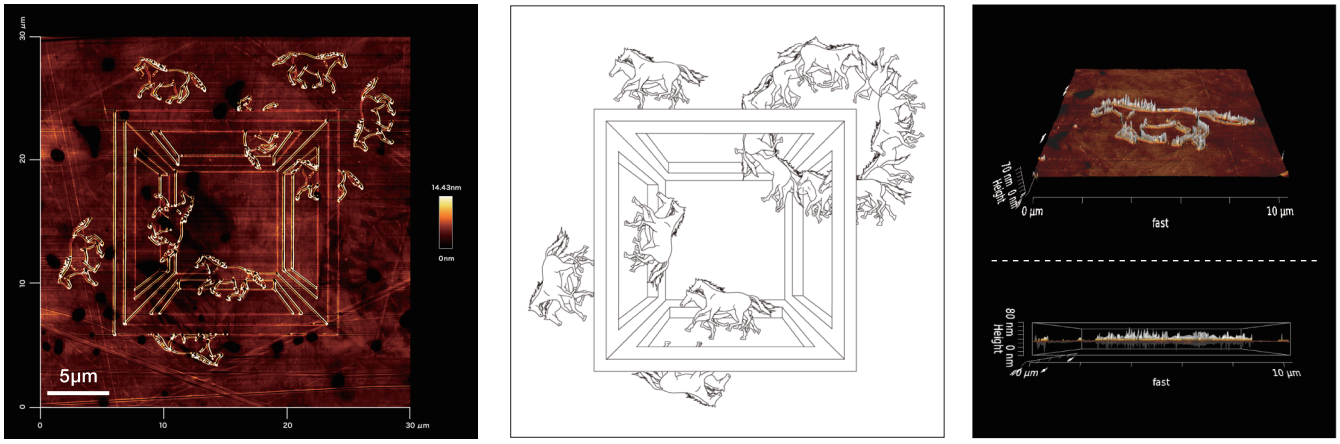

(a) (b) (c)

Figure 1 :(a) A frame taken from the 30µm sized square animation, that cannot be seen by the naked eye. We drew it on a Compact Disc (CD) (made by polycarbonate) with the cantilever (thin needle made by silicon) of an Atomic Force Microscope (AFM). (b) A line drawing for the animation. (c) The size and depth of this art displayed by the 3D viewer.

1. Introduction

Ant walks on a wall as well as on the ground, whereas horse cannot make it on a wall. However, if a horse becomes as small as an ant, the horse should be able to walk on the wall. This is because another situation may happen in such a small-scaled world where electrostatic and frictional forces are superior to gravity.

We attempted to create a micro-sized animation using state-of-art technologies and apparatuses in a scientific laboratory where I belong to as an artist. Atomic Force Microscope（AFM）（Nano Wizard2, JPK Instrument AG） is a tool to visualize the topographic features of various samples such as molecules and cells. Usually, scientists use AFM to measure and visualize the height and hardness of samples, but we used AFM for art.

2. Implementation

To create the micro-sized animation, we first drew the original pictures (Fig. 1b). Initially the pictures of the rough movement of a horse sketched by simple line drawing was tested using the frame animation mode in Photoshop. After confirming the movement of the horse, clear horse pictures were drawn by Illustrator. The surface of a Compact Disc (CD), which is made of polycarbonate, was used as a substrate to transfer the original pictures. That is to say, we used CD as a canvas to draw a picture at the micro scale. We cut a CD (the size is 15mm×30mm) so that it fits the stage of the AFM. When cutting the CD, one must be careful not to leave even the slightest dust on the surface of the CD. This is because the surface of the CD can easily be damaged in nano-scale level even with a tiny little dust that is hardly visible to the naked eye. Next, a cantilever (NCH, nanosensor) is attached to the AFM. The cantilever plays the role of a pen for the drawing. The cantilever has a thin needle (approximately 10 nm) tip made of silicon and is harder than polycarbonate. In short, drawing pictures using the AFM is to scratch the polycarbonate surface of the CD with the thin silicon cantilever. Before starting the drawing using AFM, we first searched for clean and flat areas by scanning the surface of the CD with the cantilever. The imaging mode we used was Intermittent Mode in Air. After finding a clean and flat area in the CD, the original Illustrator picture is imported to the AFM controller, and then the cantilever moves to scratch along the lines of the picture on the polycarbonate surface of the CD. During this time we changed the imaging mode to Contact Mode. We also controlled the distance between the needle and the CD to scratch the surface of the CD with a constant pressure of touch. Upon finishing the drawing, we changed the imaging mode back to Intermittent Mode in Air, and the drawn area is observed again with the cantilever. During the drawing process, loud voices, footsteps, and airflows from air conditioners should be eliminated because even the slightest sound or vibration could be a big earthquake in the microscopic world.

3. Result and Conclusion

Finally, the drawn areas are scanned again to obtain images of the micro-sized picture using an image analysis system of the AFM (Fig. 1a). The four different scanned data, of which the size is 30µm square and the depth is 15nm, are sequentially combined to create the loop animation of the micro-sized drawing using After Effects.

In this work, we realized a micro animation world, where the micro-engraved horses are galloping on the floor, running up and down the wall, and passing through the hole in this image. Inspired by M. C. Escher, we drew an event that is physically impossible to exist. This work is the exploration of wonder and infinity in the microscopic world. We hope that the resultant animation is impressive and important for both artists and scientists.

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