Metrology and Nanotechnology in Interrelation with Intellectual Property Rights

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Abstract. *Production and measurement systems reached in the past years resolution of nanometer. In this ultra small size of three dimensional structures, there can be discovered unknown physical effects for any kind of technology (electricity, friction, adhesive force,…). But it is possible that not all of this effects or manmade technologies will find protection under the existing Intellectual Property (IP) rights (IPR).*

Keywords: Nanotechnology, Semiconductor, Design of Layers and Surfaces, Metrology, Topographical Structure of Materials, Intellectual Property

1. Introduction

The history of intellectual property right (IPR) on three dimensional structures was found in the USA due to their research and industrial leadership on microelectronic and semiconductor devices in the 80's decade, like on Integrated Circuits (IC) or Central Processing Units (CPU) - or simply called Microchips or only Chips. This movement of the semiconductor industry found its result in the "Semi-conductor Chip Protection Act – SCPA" in 1984, which was called in technical terms "mask work".

The USA forced other industrial states to establish also such new IP rights to their IPR, so that treaty states mutual guarantee protection of those electronic devices, if it was applied for.

In Europe, Germany established a protection of the topography of semiconductor chips in the »Halbleiterschutzgesetz – HalbSchG« (= Semiconductor) law in 1987, in Austria the right was established as »Halbleiter-schutzgesetz – HlSchG« (= Semiconductor) law in 1988 and in Switzerland it was established as »Topographiengesetz« (= Topography) law in 1992.

To receive a protection of the semiconductor technology, the topography of the chip unit must have an own, unique character (sometimes called idiosyncrasy or secret of nature), which means that the design of it must be based on an intellectual work and not be a copy of another registered or widely

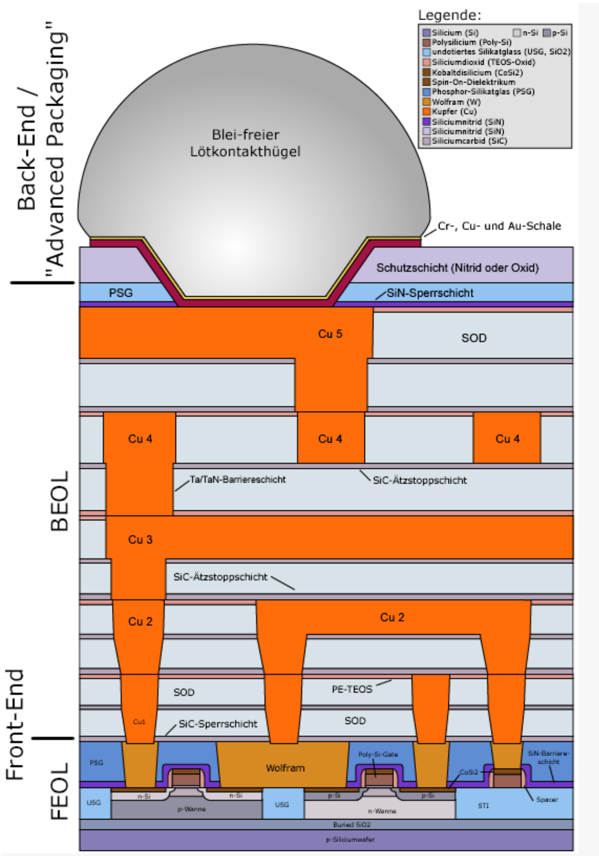

Fig. 2. Structure of a modern IC [1]

well known semiconductor topography. During the registration process in the patent offices, the application is only executed on formalities.

The maximum duration time of this industrial property right is limited up to 10 years, starting on the date of filling. The numbers of yearly applications for this industrial property right is at the moment not high, for example in Germany it is lower than 50 during the past years.

2. Metrology in Interrelation with Nanotechnology and Bionic

With the development of the Scanning Tunnelling Microscopy (STM) and the Atomic Force Microscopy (AFM) in the early 80's, a new area of metrology started. It was the first time that the resolution of microscopy reached the level of atomic structure layers or even further, the position of a single atom unit had become detectable. The STM can be operated as a measurement instrument in two modes:

- "Constant Height Mode", which allows a faster operation, but it allows no safe operation (stylus tip crashes on the surface if the profile is higher than expected),
- "Constant Gap width Mode" (CGM), also known as "Constant Current Mode" (CCM), which is slower in operation, but aware of stylus tip crashes.

A little bit later after the development of the STM microscope, another effect of this measurement instrument had been discovered: it became an atomic machine tool. Only with a slightly change of the polarity of the stylus tip, the same measurement machine became an atomic machine tool by attaching / absorbing atoms, moving them to a new position and finally emitting / dispensing those atoms on a atomic layer surface (mostly called substrate) – and this whole process is repeatable controlled by human mind. On of the first and famous images had been created by IBM researchers, who positioned single Xenon atoms on a nickel substrate in letter form, like a dot matrix printer, in 1990. The created famous first word was simply: "IBM" – as shown in Figure 2 and 3. Since that, the technology was developed much further. Nowadays, a single electron can be surrounded by a corral of Fe-Atoms. Quantum effects can be measured by the latest version of STM's in the same way like distances.

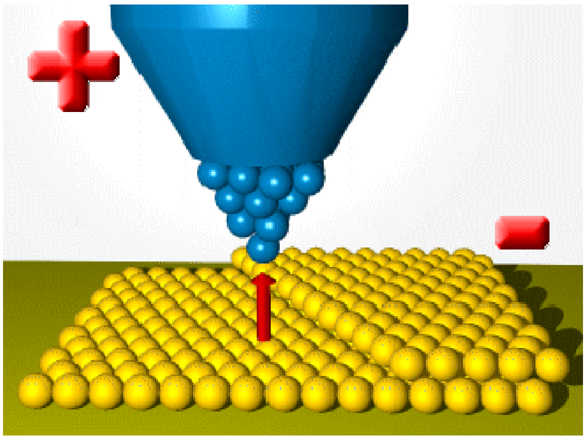

Fig. 1. STM tip functionality [2]

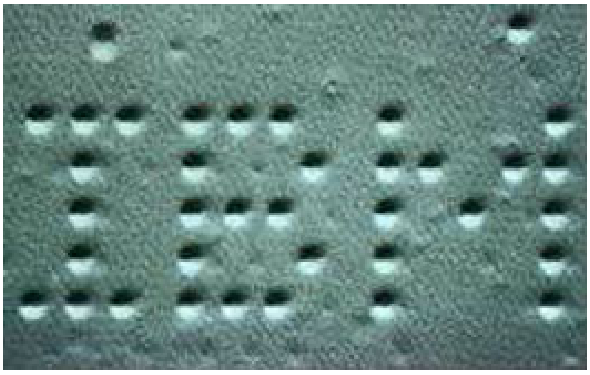

Fig. 3. Xenon atoms on a nickel surface [3]

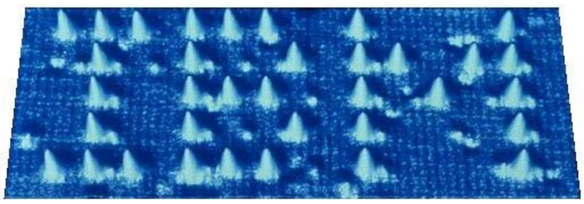

Fig. 4. Xenon atoms on a nickel surface, STM measurement result [4]

But not only in atom level the structure surface has a main impact on the physical properties, also in the nanometer level in the living nature it has effects. One of those effects, which had been scientifically investigated, was the selfcleaning effect of the lotus flower surface where water doesn't wet the surface. This effect is nowadays common well known as the "lotus-effect". In the early 70's, a German biologist – Wilhelm Bartholtt – investigated the surface structure with a scanning electron microscope. This was also the time, when bionic – scientific research of nature effects and implementation on or in machines in the industrial gods – was developed, even if it was not named so in that way at these days.

A simple explanation of the effect is: water trop has a high surface tension and follows the tendency to minimize it's surface to a sphere shape. The plant uses two effects to avoid wetting:

1. it segregates wax on the leave surface and
2. the segregate has the shape of stalagmites (tips, grains or small hills, about 10 - 20 µm high and with a distance distribution of 10 - 15 µm from each other. See Figure 5)

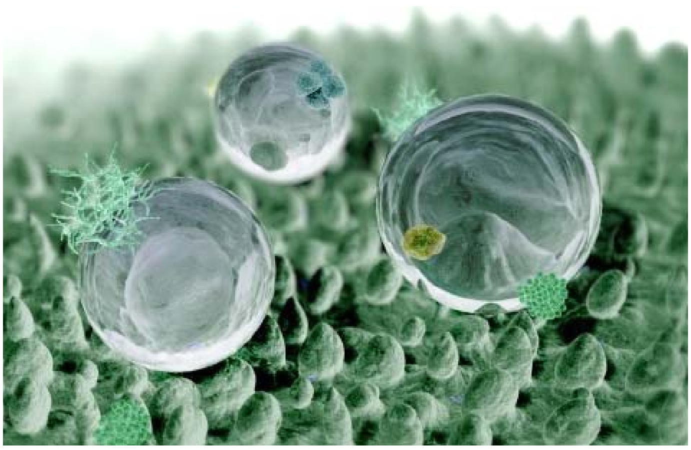

Fig. 5. Lotus-effect, virtual graphic (VG) [5]

So a water trop will be balance on the top of these tips so that less than 5% of the trop surface is in contact with the plant. Due to the surface tension of the water trop and the water resistant layer of the plant, the water trop doesn't coat the surface. With the industrial application of this effect, it is possible to reduce the amount of cleaning work of building surfaces, like facade, glass windows etc.

3. Topological Surface Structures and Intellectual Property

To fulfil positive the criteria's of the standard patent application procedure, a product, a process, a chemical substance, etc. must:

1. have a technological usability,
2. be novel,
3. have an inventive step,
4. is not based on human spirit,
5. be repeatable and finally,
6. the complete disclosure of the technology.

In the case of the Lotus-effect, this means that the effect won't be patentable, because it existed already in the nature. And if someone would find an algorithm with whom it would be possible to improve the Lotus-effect, it wouldn't also be patentable, because it is a work of human spirit. What would be patentable, would be for example, a coated film or foil which imitates the Lotus-effect, a machine which produces this kind of film or foil.

Also it seems to be possible to get protection of the product under the umbrella of the industrial design right. The industrial design right belongs also to the IPR and protects designs, if the design has a important impact on the creation of the shape, the configuration or composition of pattern or colour or combinations of both and has a product inherent three dimensional form containing special and distinguishing aesthetic values.

The important legal questions in the decision making procedure would be:

- Is it a design feature that water is not wetting the surface?
- And would be design of the surface with these countless, invisible tips for the standard average consumer and market participant identifiable?

Since the effect has a main impact from the topographical structure, so why not apply for protection under the Topography /Semiconductor law?

The application would be rejected, because it has no feature of a semiconductor device (transistors, conductive pathways, no use of electricity …). So there exists not only a "metrological gap" in this area of resolution, it exists also an "IP gap" of rights.

It would be possible for patent attorneys to reformulate the technology subject to reach an IP right under the existing patent law. But would this reformulation process really protect the invention in that way like it had been in the mind of the inventor?

True is, that nanotechnology is still a young science and only a few effects have been found nowadays and even less had been scientifically completely understood. Even more the possible technology applications are still rare in everyday consumer products. Also laws will only be established, if new society questions, cases, technologies, etc. must be regulated with new rules, so that everybody of the society can follow them. Of course, sometimes this will take decades of years, till the legal organisations will recognize these topics and pick up those demands to find practicable solutions for these questions. A good example for the "signal response time" of the legal system is the above stated "Semiconductor Chip Protection Act – SCPA" law. From the first semiconductor transistor in the laboratory in 1945 till to the protection act of 1984 it took almost 40 years for the legal system to establish (according to the demand of the industry – not on their own motivation) a practicable right [6].

If one takes this circumstance as a scale which can also be applied to this topic, it will still take some years, till new kinds or different powerful sorts of IP rights will be established.

4. Concluding Remarks

Science and technology is an on going discovering and developing process, everyday and worldwide. As in the past history, technologies had been invented which had a major impact on the society and with a delay also on the legal system.

At the moment, the legal system of any government is trying to get the last "technological revolution" – not in a scientific way, but on the economic and society impact – the internet (also called: word wide web, short: www) into useful regulations.

From the point of view of the immaterial property rights, the copyright of content in the www belongs to creator of the content – the author, exists no needs to work on that field.

For the two next technological revolutions – the genetic technology and nanotechnology – only the genetic technology is in the focus of the legal system, maybe because of the direct influence of our traditional ethic and moral values.

Nanotechnology is known most times for the semiconductor industry or for some simple visual effects, like the Lotus-effect. But IPRs would mainly be provided for electronic technologies – and this should be extended also on further technical fields.

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