

Snowmass2021 Letter of Interest
“Technology transfer from KEK to industry
-What is needed to commercialize the technology developed in high energy physics-”

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Abstract

High energy physics has developed a variety of fundamental technologies. Since industry is thirsty for innovation, it is very important to transfer the technology developed in high energy physics to industry. For this purpose, it is highly desirable to organize a group for transferring the developed technologies to industry, such as the Knowledge Transfer Group of the IPT Department at CERN. Unfortunately, KEK does not have the same system in place as CERN, but attempts are being made to transfer developed technologies to industry through the efforts of engineers and researchers. Recently we have developed a new nonevaporable getter (NEG) named oxygen-free Palladium/Titanium (oxygen-free Pd/Ti). NEG is a material that pumps residual gasses in ultra-high vacuum (UHV) after heating (activation) in UHV. We have applied for international patent and transferred this technology to three Japanese companies. After a few years of hard work, NEG pumps and NEG coating using oxygen-free Pd/Ti are commercialized. The key points of the technology transfer are 1) to achieve better performance than existing products, 2) to develop technology that dramatically lowers manufacturing costs, 3) to continue to develop the technology in response to company requests, and 4) to continue to strive for success.

Introduction

High energy physics has developed a variety of fundamental technologies. Since industry is thirsty for innovative technology, it is very important to transfer the technology developed in high energy physics to industry. For this purpose, it is highly desirable to organize a group for transferring the developed technologies to industry, such as the Knowledge Transfer Group of the IPT Department at CERN. Unfortunately, KEK does not have the same system in place as CERN, but attempts are being made to transfer developed technologies to industry through the efforts of engineers and researchers. In the present letter we report an example of technology transfer in KEK.

Backgrounds

Nonevaporable getter (NEG) pumps are widely used in accelerator facilities, because they are oil-free, noise-free, vibration-free, space-saving, energy-saving, and low-cost, and because they pump residual gasses efficiently under ultra-high vacuum (UHV) of 10^{-7} Pa or less [1, 2]. C. Benvenuti (CERN) et al. have developed a NEG coating technology to deposit TiZrV thin films on the inner surfaces of vacuum ducts by using DC magnetron sputtering [3,4]. The TiZrV-deposited vacuum ducts were found to pump residual gasses such as H₂ and CO at room temperature after baking at 180 °C for 24 hours [3, 4]. This TiZrV coating has had a great success at CERN and has been adopted at the other accelerator facilities [5]. To avoid oxidation of NEG a technology to overcoat NEG with Palladium has been developed [6,7]. This technology was transferred for industry, and applied for ion sputter pumps [8,9]. This NEG coating technology seems to be very attractive for industry such as electron microscope and photoelectron spectroscope, because UHV of 10^{-8} Pa or less are required in these fields.

Our attempts

Recently we have developed a new NEG coating technology named as oxygen-free Palladium/Titanium (oxygen-free Pd/Ti) coating [10]. Since it was found that the lower the activation temperature, the less impurities were present, we suppressed impurities in Pd/Ti to 0.05% or less to achieve an activation temperature of 133 °C or less. Thus, we named it oxygen-free Pd/Ti in analogy of oxygen-free copper. We have applied for international patent [11] and transferred this technology to three Japanese companies, that is, Osaka Vacuum, Ltd. [12], Irie Koken Co., Ltd. [13], and Baroque International, Ltd. [14]. After a few years of hard work, NEG pumps and NEG coating using oxygen-free Pd/Ti are commercialized.

Discussion

In this section we would like to discuss the factors those are important in commercialization of technology developed in high energy physics. Application for international patent is highly recommended, because companies want technology backed by patents. After patent application we must search for reliable and challenging companies that turns technology into a product. Then we should encourage companies to apply for some public grants that can be used for commercialization based on public sector patents. The technology developed in high energy physics is usually different from the technology required by industry, so continued research is needed to improve it into industrial technology. Especially technology to achieve better performance than existing products and technology that significantly reduces manufacturing costs is highly required. Unexpected trouble will occur when trying to commercialize it, so it is necessary to work with the companies to solve it. Whatever the obstacle, it is important to continue working until the products are accepted by the market. These activities will be a heavy burden for the high energy physics research, that is our most important duty. Research organization should support engineers and researchers those work to commercialize technology.

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