●Basic Stage

(Fiscal Year 2002-2004)

Kiryu and Ota Area

Research and development of the next generation Nano molding processing

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Core Research Organizations

Gunma University

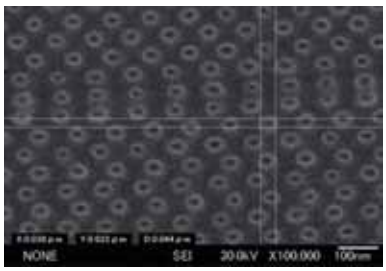
Major Participating Research Organizations

Industry…Ogihara Corporation, Miyazu Seisakusho Corporation, Tokyo Parts Industries Corporation and others
Academia…Gunma University
Government…Gunma Prefecture (Gunma Industrial Technology Center, Textile Research Institute of Gunma), Gunma Industrial Development Center

Typical result of City Area Program

1. Development of nano/micro meters scale dies

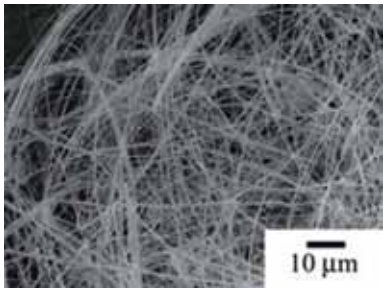
The following technologies developed: fabrication of nano- dot /pyramid dies by an electron beam lithography and silicon process, development of a laser direct drawing system as a photolithography of machine, creation of micro-dies of high aspect ratio and die-forging of a coil for high frequency hybrid magnetic element, fabrication of nanometer scale dies of various materials and with these dies, micro gears of diameter 1 μm were formed. Nano-dot-dies of 40nm in intervals were fabricated with FIB-machine and nanoimprint of a metallic glass was performed with the dies. Interference optical elements such as a grating and a hologram were developed by die forging of metallic glass with dies that were fabricated by nanometer scale lithography in large area by laser interference and successive electroforming.



SEM image of small bit string:Bit size 35nmx50nm , Bit pitch 100nm , Track pitch 50nm

2. Development of a mass production system of silicon carbide nanofibers

A polymer blend consisting of carbon precursor polymer matrix and fine silicon carbide precursor polymer particles is melt-spun, stabilized and carbonized. After the removal of carbon matrix in the resulting fibers with a nitric acid solution, the released silicon carbide nanofibers with several 100nm in diameter are recovered. This is only one possible method to lead to mass-production of silicon carbide nanofibers in the world. The scale-up of the process and characterization of the nanofibers must be done from now. The nanofibers are expected to be used as a reinforcement filler for metal- or ceramic-based nanocomposites, a high quality filter and so on.

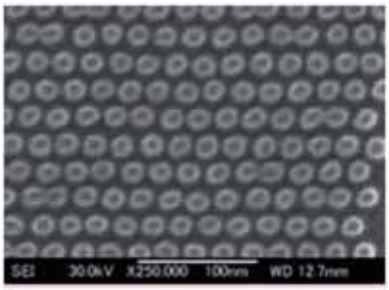


Electron microgram of silicon carbide nanofiber produced with this method

About the approach after the project

1. Development of key technology in terabit patterning for the ultrahigh density recording disc

This is the world first formation of the nano dot arrays in a diameter of about 13nm with a track pitch of 25nm and a bit pitch of 25nm in the negative resist using the electron beam writing. It corresponds to ultrahigh density of about 2Tb/inch^2 for an optical disc about 1Tb/inch^2 for the patterned media required for magnetic disks. This is 300 times higher than that of the DVD available in the market, and even 100 times of blue disk (40GigaByte). Based on this development, we continue to study the application to achieve an ultrahigh density recording disc.



SEM image of small bit arrays: Dot diameter of 13nm , Bit pitch of 25nm , Track pitch of 25nm

2. Promotion of research and development of the next generation Nano molding processing

Other than above, in the research on high frequency hybrid magnetic device, magnetic thin film and mounting coil, which can be used up to 2GHz class devices, were successfully developed. The recombinant bacterioferritin was prepared using gene engineering technique and purified for construction of protein monolayer. Two dimensional crystals of the bacterioferritin were observed and analyzed by electron microscope, and expected for the novel nano layout element.

The next generation Nano molding processing has been progressed even after the project through promotion of Regional New Consortium R&D Project, as well as making use of the industry-academia-government cooperation projects for donation. Therefore, the joint projects continued making efforts to create a new consortium in the region.