MicroscopyPioneers

Pioneers in Optics: Richard Adolph Zsigmondy and Thomas Young

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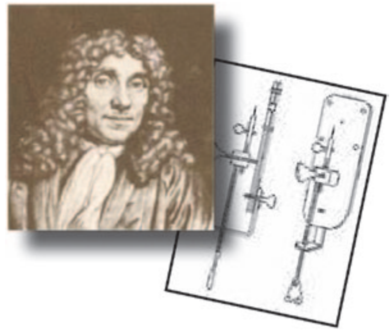

Richard Adolph Zsigmondy
(1865–1929)

Richard Adolph Zsigmondy was an Austrian chemist and professor who invented the ultramicroscope and used the device to make numerous discoveries regarding the nature of colloids. Born on April 1, 1865, Zsigmondy was one of four sons of a well-respected dentist and inventor of surgical instruments who instilled in his children an interest in the natural sciences. In his youth, Zsigmondy was particularly interested in physics and chemistry but was also fond of outdoor activities such as mountaineering and swimming. Although his father died when he was a teenager, his mother continued to encourage his pursuit of knowledge.

After graduating from high school in 1883, Zsigmondy began studies at the Vienna Polytechnic University. There he majored in chemistry and received his degree in 1887. He went on to pursue his doctorate in organic chemistry, continuing his education at the University of Munich. After he completed his degree, Zsigmondy accepted a position as research assistant for the physicist Professor Kundt at the University of Berlin. Kundt, who was a specialist on the colorization of glass by inorganic matter, helped promote Zsigmondy's interest in the area.

Although he accepted a teaching position at the Polytechnic University in Graz, Austria, in 1893, Zsigmondy's interest in colored glass did not wane. When he joined the Schott Glass Company in Jena, Germany, in 1897 he continued his efforts in the area and developed what came to be known as Jena milk glass, an extremely popular commodity. This same work led to his increased involvement with colloids, which are often the basis for the colorization of glassy materials. Frustrated with the inability of ordinary light microscopes to aid in his research because of the extremely small size of colloidal particles, Zsigmondy decided to find a way to correct the problem.

In 1900 Zsigmondy left the working world and devoted himself for the next seven years to independent scholarly research, financed by a family fortune. It was during this time that he developed his ultramicroscope, working in conjunction with physicist Heinrich F. W. Siedentopf of the Zeiss optical works. The instrument, completed in 1903, illuminated colloidal particles with an intense beam of light oriented in a position perpendicular to the microscope's optical axis. As particles scattered the incident light, their movements could be seen as flashes against a dark background. The invention was a tremendous breakthrough in colloidal chemistry, enabling Zsigmondy and others to make observations and conclusions that were never before feasible.

Zsigmondy returned to academia in 1907, accepting a professorship and position as director of the Institute of Inorganic Chemistry at the University of Göttingen, but he continued his work in colloidal chemistry. His efforts to improve on the design of the ultramicroscope resulted in the invention of the immersion ultramicroscope in 1913. Then, in 1925, he received the crowning glory of his career when he was awarded the Nobel Prize in Chemistry for his inventions and colloid research. Zsigmondy retired from his academic posts in February, 1929, and died later that same year from arteriosclerosis.

Thomas Young
(1773–1829)

Thomas Young's epitaph in Westminster Abbey reads that he was "A man alike eminent in almost every department of human learning." Young was an English physician and a physicist who was responsible for many

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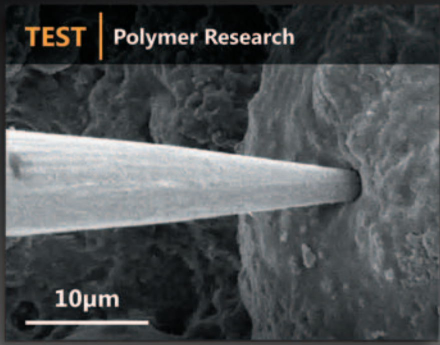

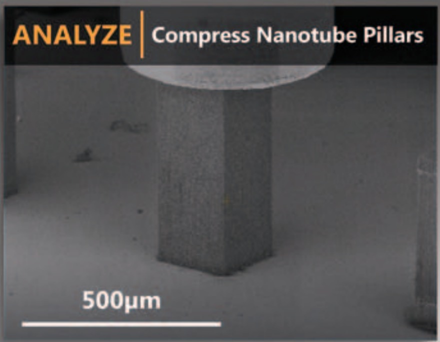

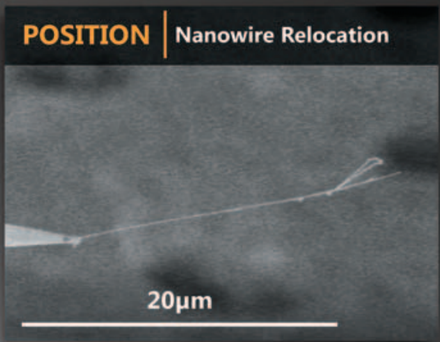

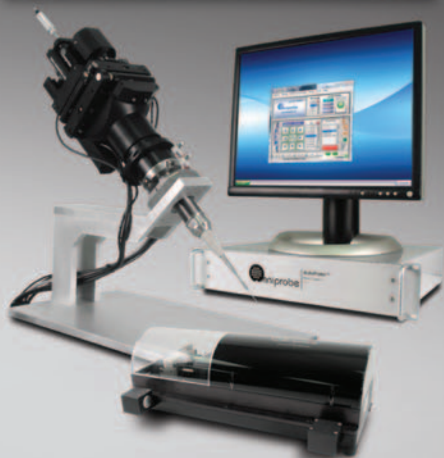

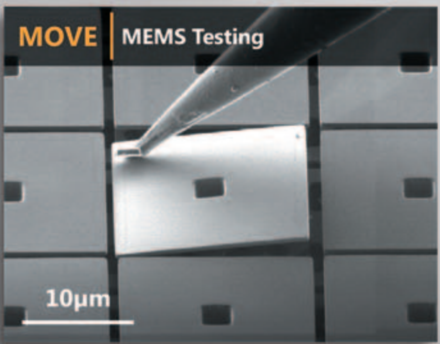

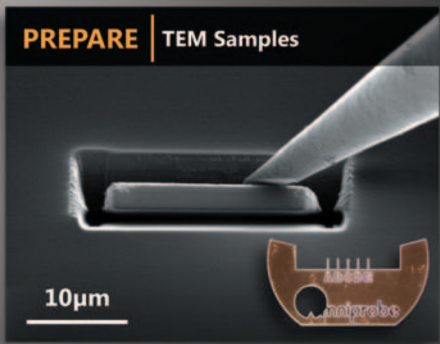

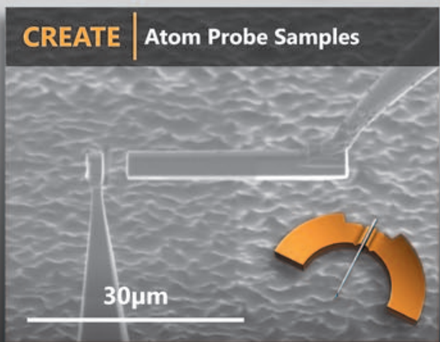

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important theories and discoveries in optics and in human anatomy.

In 1799 Young initiated his medical practice in London. His primary interest was in studying sensory perception and, while still in medical school, discovered how the lens of the human eye changes shape to focus on objects at different distances. While pursuing his interests in the function of the human eye, Young discovered the cause of astigmatism in 1801, which was about the time that he began his study of light.

In 1801 Young began a series of experiments that addressed a phenomenon known as interference. He observed that when light from a single source is separated into two beams and the two beams are recombined, the combined beams produce a pattern of light and dark fringes. Young concluded that these fringes were the result of the beams of light behaving as waves with their peaks and troughs either reinforcing one another or canceling each other. When this occurred, alternating lines of light and dark resulted.

Young applied his new wave theory of light to explain the colors of thin films such as soap bubbles, and by relating color to wavelength, he calculated the approximate wavelengths of the seven colors recognized by Newton. His proposal of this wave theory of light was not accepted by most English scientists of the period because it opposed Newton's theory of light. It was not until Young worked with French physicists Augustin Fresnel and Francois Arago that his wave theory began to be accepted in Europe.

Young was also responsible for postulating how the receptors in the eye perceive colors. He is credited, along with Hermann Ludwig Ferdinand von Helmholtz, for developing the Young-Helmholtz trichromatic theory. This theory postulated that there were three distinct types of cones in the retina and that each one of the types was sensitive to a particular color—either red, green, or blue. They also speculated that when a color stimulus was captured by the eye it was the cone receptor structures that received and transmitted that information to the brain.

As indicated by his epitaph, Young's interests and mastery of scientific and medical skills was quite varied. He was fluent in several languages and studied Egyptology. He also began studying the texts of the Rosetta Stone in 1814. After obtaining additional hieroglyphic writings from other sources, he succeeded in providing a relatively accurate translation and contributed to the deciphering of the ancient Egyptian language.

Young also did experiments concerned with measuring the size of molecules, surface tension in liquids, and quantities of elasticity. He was also the first scientist to give the word "energy" its scientific connotation. Moreover, Young's modulus, a constant in the mathematical equation describing elasticity, was named in his honor.

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