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Pre-Kymeta Series Part 2: The Invisibility Cloak

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With every revolutionary idea, comes skepticism and criticism. In 2002, metamaterials and negative refraction became a topic of intense controversy. Specifically, whether a beam bending in the "wrong" direction violated the fundamental laws of physics. Several groups questioned the entire reality of negative refraction and metamaterials — concepts that were extremely confusing to many people.

After the first paper on negative index was published by David R. Smith, debates began swirling. Many well-known physicists questioned the experimental results and disputed whether negative refraction could exist. This controversy raged for a couple of years.

In 2004 Nathan Myhrvold and Casey Tegreene, Intellectual Ventures (IV) CEO and EVP respectively, contacted Dr. Smith. They were interested in creating an IP portfolio around metamaterials, even though they didn't know what metamaterials would be good for. Rather than being scared off by the controversy and ongoing debates, they became intrigued. The vigorous debate and cool ideas coming out of the research sparked the initial IV investment in metamaterials.

In the coming months and years, there were additional experiments and many award-winning papers published on metamaterials. One noteworthy project that catapulted metamaterials firmly into the mainstream was the invisibility cloak experiment. In 2006, Sir John Pendry, in collaboration with David Smith and his group at Duke University, sought a design tool that would fully harness the new properties unlocked by metamaterials. In that process, they came up with the idea of bending light in such a way that it could form a container around an object, which would effectively make the object invisible. This new tool, called transformation optics, and the invisibility cloak design were reported in a paper published in Science, generating enormous interest not only from the scientific community, but also from the mainstream media. Subsequently, Dr. Smith led the team in demonstrating a metamaterial cloaking structure at microwave frequencies, a result published four months later, also in Science. The cloak decisively demonstrated the power of transformation optics that Dr. Pendry had conceptualized, expanding the set of tools available for optical and electromagnetic design. Transformation optics and related techniques would later become part of the underlying tool set for Kymeta's technology.

The metamaterial invisibility cloak received a lot of attention due to the cool-factor, however, it wasn't practical. The metamaterial implementations of transformation optical designs have inherently large absorption, and have properties that varied rapidly with wavelength. This wavelength variation means that metamaterial cloaks have an inherently narrow bandwidth. The cloak Pendry and Smith demonstrated worked at only one frequency, making it impractical for broader uses.

Yet the underlying concept was compelling. Because of the invisibility cloak initiative, the field of metamaterials drew even more attention. The cloaking experiment ultimately kept the study of metamaterials alive and Myhrvold was even more intrigued given the increased excitement.

There was now tangible proof of the power of metamaterials, yet, it was still unclear what practical uses it might have.

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