# Patenting photonics research

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Issues concerning intellectual property often rank low on the list of priorities of scientists focused on primary photonics research. However, ignorance of such matters can lead to missed opportunities, litigation or severely hinder the success of a start-up company.

With the level of investment and innovation in photonics increasing rapidly in recent years, the race to commercialize technology is becoming more competitive. Intellectual property (IP), and patents in particular, often form an important keystone around which innovations may be successfully commercialized. Start-up companies and university spin-outs typically rely heavily on patents to secure investment and to provide a means of commercializing their innovations that is not otherwise available to them.

Photonics start-up companies that have carefully managed the IP in their inventions have shown themselves to be a significant force in the photonics marketplace. Although the success of such start-ups rests on many factors, not least the popularity of their inventions, careful IP management is another important factor. Perhaps a well known example is that of Cambridge Display Technology (CDT), a spin-out formed to commercialize novel light-emitting materials discovered at the University of Cambridge, which has so far secured considerable expansion and revenue in this way.

It is not surprising then, that the ongoing surge in research and development activity in photonics has been mirrored by a clear surge in the number of patent application filings in both photonics and nanotechnology — often intimately related fields of research and technology[1]. Figure 1 shows the distribution of the relative numbers of photonics and nanotechnology published patent applications filed over the period 1995 to 2004 (ref. 2).

However, this does not mean to say that there is commercial value in patenting each and every photonic innovation. Ultimately, a patent is of value when the benefit of having the patent outweighs the costs of procuring and maintaining the patent. A crude measure of the value of a patent is the value of the patented invention less the value of the invention with no patent.

This premium can be difficult to quantify with certainty, however, recent studies carried out for the European Commission, Directorate General for the Internal Market, have suggested that this premium, in relation to European patents in eight of the main industrial nations (UK, Germany, France, Italy, Spain, Denmark, the Netherlands and Hungary) in the European Union, may typically be approximately €300,000 — accounting for an increasing share of gross domestic product in those countries[3].

Although directly exploiting patents by licensing them to third parties provides an effective way of generating revenue and enhancing the value of a patent, it is by no means the only measure of a patent's value.

The indirect effect of the mere existence of a patent, in blocking direct commercial competition, can be significant in enabling the patent holder or licensee to secure a position

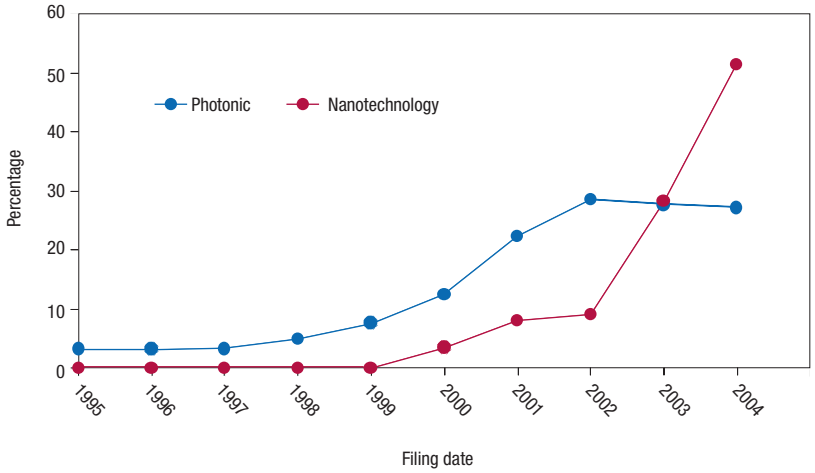


**Figure 1** Patent applications filed between 1995 and 2005. Each data point represents the number of applications filed in the given year divided by the total number of applications in that field over the ten-year period. The data relating to photonics shows the relative numbers of patent applications containing the word 'photonic' in the abstract[2]. The data relating to nanotechnology shows the relative numbers of patent applications classified within International Patent Classification B82 (nanotechnology)[2].

## Box 1 Free-electron laser but not so free

In 1984, while on the faculty of Stanford University, John Madey invented the first free-electron laser (FEL). United States patents US4641103 and US5130994 were granted to Madey for critical elements of the technology. Madey's FEL, once the keystone for President Ronald Reagan's 'Star Wars' missile defence project, moved to Duke University (USA) when Madey left Stanford University in 1988 for a tenured position at the Duke University Physics Department.

A disagreement between Madey and Duke University resulted in Madey moving to the University of Hawaii and requesting to take the FEL with him. Duke University refused to relinquish the FEL, which it continued to use, and Madey sued for infringement of his patents.

Duke University claimed that by being a non-profit organization conducting academic research, not business, it was exempt from liability for patent infringement. The appeals court disagreed, noting that since Duke University is in the business of pursuing research, it does not enjoy the exemption it claimed, even though it is a non-profit organization. The ruling shocked the US academic research community.

in a relevant technology market, and direct enforcement of a patent may maintain a leading position in that field (Box 1). Direct exploitation by licensing is favoured predominantly by small businesses, and especially by universities, who tend to have smaller patent portfolios focused on core technologies. However, the use of patents to indirectly block competitors tends to account for an increasing proportion of an organization's patent portfolio as the organization grows in size.

Studies have shown that public research institutions are typically willing to license around 50% of their European patent portfolio, whereas large companies tend to license only about 15% (ref. 4). This reflects the need of public research institutions to use their patents to access the capabilities and assets of industry to exploit their innovations.

### UNIVERSITY–INDUSTRY COLLABORATIONS

University–industry collaborations can, of course, take many forms but many are concerned with commercializing new inventions and discoveries, which result from scientific research conducted, at least partly, at a public research organization. One of the key aims of a technology-transfer relationship between university and industry partners is to ensure that any IP arising from research is fully exploited. Clearly, a preferred arrangement is that the partner most able to pursue commercial exploitation (often the industry partner) has sufficient access to the IP to ensure that the enterprise is successful.

From the outset of such a partnership, clear arrangements should be put in place concerning the management of any IP relating to innovations or findings resulting from the partnership. This may include experimental or theoretical results, new designs, new knowledge and technical know-how. All of this may generate IP and it is important to have a clear understanding of how it will be managed.

Arrangements should address access to background IP that may be helpful, or even essential, in enabling successful development or commercialization of a new innovation, or both. This applies not only to relevant IP owned by third parties, but also to background IP owned by any of the two collaborating partners themselves.

Broadly speaking, four different strategies for securing or managing IP include: formal protection (for example, patents); confidentiality agreements between collaborating parties; deliberate public disclosure; and doing nothing.

Deliberate public disclosure, or simply doing nothing to manage IP, can sometimes enable a rapid take-up of technology and may promote the creation of an open standard for a new technology. In addition, public disclosure may be done defensively to hinder or prevent acquisition of IP by others for the technology in question[4].

Confidentiality is, of course, useful in keeping developments out of the reach of competitors, such as competing research groups or companies, but may conflict with a university's need to publish its research to establish status, and have an impact on funding assessments. Formalized protection, such as patents, enables disclosure at much less risk.

Whatever the most suitable IP management strategy may be for a given partnership, it is very important that all those involved have an understanding of when a disclosure of information about an invention can jeopardize a patent application made at a later date. In general, and in most circumstances, making information about an invention 'available to the public' in any way before a patent application has been filed can jeopardize the subsequent patent application. This should be strenuously avoided.

Examples of making such information available to the public — with potentially disastrous consequences if done before a patent application is filed — include disclosing the information in: seminars, poster sessions, or abstracts; trade or scientific publications; interviews with journalists; informal discussions (for example by word or e-mail) with third parties without a confidentiality agreement; submission of a thesis to a library without requesting library restriction; or a website. (It should be noted that this list is not exhaustive.)

Box 2 describes the typical sequence of events in the UK patent application process. In general, patent offices are obliged to publish the contents of a patent application at some point after it has been filed with them. Until that time, the contents of the patent application remain secret unless the applicant has publicly disclosed the invention beforehand. The question of whether or not it would be safe for the patent applicant to disclose the invention to the public soon after filing their patent application cannot be answered simply. What can and cannot be disclosed depends on the applicant's future patenting strategy for their invention. As it is not always possible to know how that patenting strategy will progress, the bottom line is that there is always some risk that a public disclosure may jeopardize a patent application. Therefore, the decision whether or not to publicly disclose the invention will probably depend on where the level of acceptable risk lies.

Many patent applicants disclose their invention soon after filing a patent application for it. Any public disclosure would not count against that particular patent application provided that the disclosure does not go beyond what is contained in the application.

However, if an inventor decides to pursue patent protection for their invention in several countries, then they will probably file further applications (in other countries) within 12 months of the filing date of their initial patent application. Those later applications will probably claim 'priority' from the

## Box 2 Patents: The basics

A patent is a legal right granted by a Patent Office for a new invention. In most countries, the right has a maximum lifetime of 20 years from the date of the patent application. To obtain a patent, it is normally necessary to apply to the Patent Office of the country in which patent rights are desired. If it is decided that the invention is patentable, the patent will be granted, usually several years later. For example, Fig. B2 illustrates the typical procedures and timescales involved in applying for, obtaining and maintaining a UK patent. Equivalent procedures in other countries depend on national patent law and vary considerably, as do the typical costs involved at each stage.

A patent typically belongs to the inventor, unless he or she has given the rights to someone else. For example, if the inventor is an employee and he or she makes the invention in the course of his or her work, the rights may belong to the employer.

In the UK and, in fact, in many other countries, in order to be patentable, the invention must at least meet the following conditions:

- It must be new; that is, the invention must not have been made public in any way before the application to the Patent Office is made.
- It must involve an inventive step. This means that the invention must not simply be an obvious development of something that is already known.
- It must be capable of being made or used in any kind of industry.
- It must not fall into an excluded category. Examples include works of art, scientific theories and mathematical methods.

In short, a valid patent gives its owner the legal right to prevent others, within the jurisdiction of the patent, from using the invention for generally commercial purposes without the patent owner's permission. Thus, the buying, selling or licensing of a patent is, in effect, the trading in this legal right. However, although a patent may give its owner a legal right to prevent unauthorized use of the patented invention by others, it does not automatically give the owner the right to use the invention. If the patented invention falls within the scope of a third party's patent rights, or other IP rights, then it would be necessary to obtain a licence from the third party before the invention can be exploited commercially, without infringing those rights.

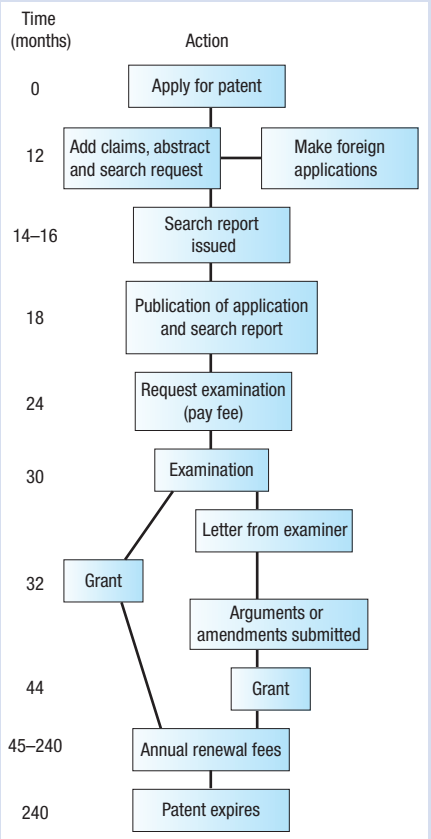


**Figure B2** A flow chart of the UK patent application process.

initial application (so as to backdate them, in effect). The act of claiming priority may only be fully effective in backdating the later applications if the information in those later applications is also disclosed in the initial application. As it is common practice to include, within the later applications, any improvements to the invention that were made in the intervening period, it is important that any such improvements are not publicly disclosed in the meantime. This is because those improvements would not be disclosed in the initial application and so may not benefit from the priority claim. The result could be that the public disclosure by the applicant, of the improvements made in the intervening period, may jeopardize the later patent applications.

Furthermore, it is possible that an applicant may decide to abandon the initial application (before the patent office has published it) and refile at a later date, for example if significant improvements have been made, or for tactical reasons. Again, if the applicant had publicly disclosed some or all of the contents of this initial application, before the date of refiling, then the refiled application containing the improvements may well not be patentable, because the general concept of the invention would have been disclosed, albeit without the improvements.

## CONCLUSION

With innovation in photonics and nanotechnology rapidly increasing in recent years, competition in the market place will surely increase in tandem. Intellectual property rights, especially patent rights, have been shown to be key to securing the successful commercialization of research innovations. This is especially so for small start-up companies who rely on one or a few core technologies and have little or no market share, but plenty of competition. Enterprises such as these have shown themselves able to succeed by, at least in part, securing and carefully exploiting IP in their innovations.

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