

Hong Kong team develops the most energy-efficient LED filament lamps

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PolyU's LED filament bulb and other bulbs. Credit: The Hong Kong Polytechnic University

A research team of State Key Laboratory of Ultra-precision Machining Technology (Partner Laboratory in The Hong Kong Polytechnic

University) and PolyU students has successfully developed the most energy-efficient Light Emitting Diode (LED) filament technology with a luminous efficacy of 129lm/W, which represents 1.5 times the efficacy of traditional LED lamps, surpassing all other general lighting tools available in the market.

This LED filament technology has excellent energy efficiency. Based on the assumption of a daily operation of eight hours, a PolyU's LED filament bulb with lumen of 1300lm costs HK\$33 of electricity tariff per year, and contributes to 22kg of [carbon dioxide emission](#) yearly. In comparison, a traditional LED lamp costs HK\$47 of electricity tariff and 31kg of carbon dioxide emission yearly with the same lumen and conditions, which means that the new technology can reduce carbon dioxide emission by 30%. Besides, the new technology enables an expected lifetime of 50,000 hours, with only half of the production cost of traditional LED lamps.

Thanks to its energy-saving and long lifetime features, LED lighting contributes significantly to sustainable development. However, the limitations of traditional LED lamps, including high production cost and narrow beam angle have affected its popularity. The LED filament technology developed by PolyU has not only achieved breakthrough in the areas of energy efficiency, lifetime, and production cost, but it also has other advantages including:

1. Wide beam angle: 300-degree, parallels to that of incandescent bulb;
2. Comparably high colour rendering index (CRI): Enables original colour projection of objects as if they are in natural light;
3. Less UV light emission; and
4. More environmental friendly: Absence of harmful chemicals, and

consists of less electronic components, and 80% of recyclable materials.



The LED filament bulb developed by PolyU. Credit: The Hong Kong Polytechnic University

These breakthroughs are made possible by the following technology advancement:

1. Using Aluminium as substrate material LED chips are sensitive to heat. Heat diminishes its luminosity and speeds up the drop of lumen, and therefore heat flow design of substrate is crucial to the lifetime of LED lamps. Instead of ceramic and sapphires, Aluminium, with good thermal conductivity, high reflectivity and affordable price, is chosen as the substrate material, to achieve longer lifetime and higher lumen at a lower cost.

2. Mounting LED chips of small power on both sides of substrate The larger the power (Watt) of a LED chip is, the higher the electric current it needs, leading to more energy loss. In PolyU's LED filament lamp, LED chips with large power are replaced by many tiny LED chips with small power which are mounted on both sides of the substrate. This design will reduce energy loss and generate even light diffusion, without affecting luminosity.

3. Applying PolyU's advanced injection moulding technology Hemispherical plastic case of LED lamps made with traditional plastic moulding method limits beam angle. Applying advanced injection moulding [technology](#) developed by PolyU Advanced Optics Manufacturing Centre, a seamless and transparent spherical plastic case is produced to make 300-degree beam angle possible.

4. Enhancing power supply PolyU LED filament lamp converts AC (alternate current) to low current DC (direct current) directly without dealing with the voltage, and hence reduces components required and simplifies circuits, enhancing reliability and efficiency of the lamp.

The patent application of this [new technology](#) has been filed and the prototype design is completed. In future, the team will conduct various tests and obtain certifications for market launch.

Provided by Hong Kong Polytechnic University

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