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An invention of brilliant coil-EEFL lamps with WDC=0 in operation

Abstract

We have invented the coil-EEFL lamps that have the zero electric power consumption in the operation; WDC=0, after the critical review on the concepts of the established FL lamps in the past 90 years. We apply the new concepts to the FL lamps. The coil-EEFL lamps light up with the moving electrons in the internal DC riving circuit in the Ar gas with the high quantum efficiency of ηq=1013 visible photons (m2, s)-1, with the operation life longer than 106 hours. The electric power consumption of the external driving circuit is zero. The developed coil-EEFL lamps may immediately supply the light source to the undeveloped countries on the world without the distribution lines from the power generators.

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Introduction

The light sources are necessaries of our life activity. The candescent lamps utilize the lights from the fire-flame by the chemical reaction of organic materials with oxygen in air. The heat of the fire-flame is generated by the change of the entropy. After the finding of atoms and electrons on 1800s, the major light sources change to the incandescent lamps. Incandescent lamps generate the lights in the visible spectral wavelengths by the moving electrons in metal filaments, solid compounds, and gases. The figure of the merit of the incandescent lamps is given by the quantum efficiency (η_q) that is given by the numbers of the emitted visible photons per m^2 from the lamps by one moving electron per second. The lighting mechanisms of the incandescent lamps change with the kinds of the incandescent lamps.

Metal lamps

The metal are formed with the metallic bound with the electrons in either one of s, p, d, and f shells in which the electron shell has vacancy of electrons. Accordingly, the electrons in the metals move on in the inside of the bonding shell of the metal atoms. The moving electrons never step in the vacuum space between metal atoms at lattice sites. The moving electrons in metals inevitably have the Joule Heat that is given by I^2R, where I is electric current and R is electric resistance. R is determined by thermal perturbation of moving electrons from neighboring atoms that thermally vibrate at lattice sites.[1–3] The heated metal filament lamps emit the lights in the wide spectral wavelengths from the near UV lights to the infrared lights. We cannot calculate the η_q of the metal filament lamps. The metal filament lamps do not have the capability to the Green Energy Project by the UN.

The atoms in the LED and FL lamps totally differ from the metal lamp. The atoms in the LED and FL lamps do not form the metallic bonding. The atoms float in the vacuum. The solid and gas totally have the different vacuum conditions. The solid atoms of the LED lamps are arranged at lattice sites with the small separation distance at around 10^{-9} m. On the other hand, the Ar atoms in the FL lamp float in the vacuum with the separation distance around 10^{-6} m. The LED lamps use the solids, and FL lamps use the atoms in gas phase. The both LED and FL lamps light up with the quite different mechanisms. We will give a brief summary of the lighting mechanisms of the LED and FL lamps respectively.

LED lamps

The LED lamps are produced with III-V compounds that are made by the covalent bounding. The covalent bounding does not have the vacancy in the bonding shell. The electrons in the LED lamps only move on in the narrow vacuum space between atoms arranged at lattice sites of the crystals. Consequently, the moving electrons in the LED lamps inevitably have the R. The LED lamps unavoidably heat up by the Joule Heat (I^2R). The maximum numbers of the moving electrons of the LED lamps are restricted in the allowed temperature of the lighted LED lamps. The allowed maximum temperature of the LED lamps is around 70°C. The visible photons in the LED lamps are generated by the recombination of the pairs of the injected electrons and holes from the attached electrodes of the LED lamps. Therefore, we can calculate the allowed numbers of the injected electrons from the attached metal electrodes into the LED lamp. We also measure the numbers of the emitted visible photons per second. Then, we have obtained the η_q of the LED lamp.[1–3] The LED lamp emits one visible photon with two pairs of the electrons and holes that gives $\eta_q \approx 0.5$, with the energy loss by the Joule Heat, The amount of the Joule Heat changes with the thickness of the LED lamp. If the LED lamps are produced with the extremely thin III-V semiconductor, one may produced the $\eta_q \approx 1.0$ with the extremely thin LED lamps, giving rise to the double illuminance (lm, m^{-2}) with the negligible energy loss by the Joule Heat in the operation. You cannot increase the further illuminance. This is the limitation. Then, it can say that the LED lamps are the power hungry incandescent lamps. The LED lamps do not contribute to the Green Energy Project of UN, even though the inventors and producers claim it.

FL lamps

On the other hand, the Ar atoms in the FL lamp float in the vacuum with the large separation distance at around 10^{-6} m. Consequently, individual Ar atoms form the gas. The vacuum space between floating Ar atoms in the vacuum in unlighted FL lamps fills up with the negative electric field. The unlighted FL lamp is the electric insulator. In the lighted FL lamps, the negative electric filed in the vacuum between the cathode and anode of the FL lamps is neutralized by the presence of the ionized Ar^{1+}. The neutralized wide vacuum between Ar atoms in the lighted FL lamps changes to the superconductive vacuum at above room temperature.[1–3] The moving electrons in the

superconductive vacuum in the FL lamps never lose the energy by the Joule Heat. The moving electrons in the lighted FL lamps only lose the kinetic energy by the Coulomb's repulsions with the floating Ar atoms. The Coulomb's repulsion generate the Ar^{1+}, free electrons (e), excited Ar atoms (Ar*) in the positive column in the lighted FL lamps. The heat source in the lighted FL lamps attributes to the ionization of the Ar atoms by the change in the entropy. The generated Ar^{1+} and e by the ionization are invisible particles in the Ar gas space. Only Ar* emits the visible photons within 10^{-6} second after the excitation. The generated Ar^{1+} and e return to Ar atom with recombination in the lighted FL lamp. We only calculate the Ar^{1+} and excited Ar* in the lighted FL lamp as the statistical results in the unit time; e.g., one second. The statistical consideration is a necessary condition for the study on the FL lamps.

However, we cannot find the η_q (= numbers of visible photons per second) in the study of the lighted FL lamps for the last 90 years,[4–8] even though the annual production of the FL lamps are more than multi-multimillions.

We may calculate the numbers of the Ar atoms in the FL lamp at pressure of 930 Pa (7 Torr). The numbers of the Ar atoms in a given FL lamp is calculated from the Boyle-Charles law (PV=mRT) and Avogadro's numbers. Where P is pressure at atmosphere, V is inner volume of the FL lamp, m is mole, R is gas constant (8.32 J/K. mol), and T is temperature by °K. The rounded Ar gas pressure (P) in the FL lamp is ≈0.01 atmospheres {=7 Torrx(760 Torr)$^{-1}$}. RT=2.5x10^3 Joule (=8.32 J/Kx300 °K). P/(RT)=4x10^{-6} {=(1x10^{-2}) x (2.5x10^3)$^{-1}$}. Mole of the Ar gas in the FL tube is given by {m=VxP(RT)$^{-1}$} that is 2.8x10^{-9} mole (=x10^{-6}x7x10^{-4} m^3). The numbers of the Ar gas atoms in the FL lamp are calculated by the Avogadro's number (6x10^{23} per mole). The numbers of Ar atoms in the FL lamp are calculated as 1.7x10^{15} Ar atoms (=6x10^{23}x2.8x10^{-9} mole).

Recently, we have statistically calculated the η_q of the lighted 40W-HCFL lamps.[1–3] The commercial 40W-HCFL lamps have the η_q=10^{13} photons (m^2, s)$^{-1}$. The moving electrons in the FL lamps are 3x10^{-4} A that contains 2x10^{15} electrons per second. Consequently, the commercial 40W-HCFL lamps emit 10^{25} visible photons (m^2, s)$^{-1}$, which is equivalent with the illuminance (300 lm, m^{-2}). The commercial HCFL lamps surely have the high potentials of the contribution to the Green Energy Project with the astronomically high η_q.

However, we have found the advantage of the FL lamps over the LED lamps. We have found the reasons. The established technologies of the commercial HCFL lamps for the 90 years are based on the hypotheses without the scientific proofs. They have empirically developed hot cathode FL lamps that are HCFL lamps.[4–8] Furthermore, the Japanese Government has ordered the termination of the production of the FL lamps as the severe poison of Hg atoms for the human body, using Minamata disease. And then, the Japanese Government has taken the action to UN as the severe poison of Hg atoms to the human society. The Minamata disease is actually caused with the organic methane Hg (NH_4Hg). When the mother has taken the small fishes that are contaminated (NH_4Hg), the mother does not have the difficulty in her daily activity. When the mother is pregnant, only fetus in early stage less than 3 months selectively receives the contaminated organic NH_4Hg cell from the mother. The brain of the fetus is completely damaged by the organic NH_4Hg for all his life. But others cells of the fetus do not damaged by the organic NH_4Hg. The baby of the contaminated fetus grows up with the normal human body. The victim of Minamata disease is the limited numbers in the small poor fishing villages, not Minamata City and the world. The chemical factories in USA and EU widely use the organic NH_4Hg catalysis. They well control the discharge of the organic NH_4Hg from the factories. The Japanese Government must have the action of the withdrawal of their proposal from UN. It is said again the Hg droplets are not poison to human boy. The human society has used Hg atoms for more than 4000 year without any troubles. We can safely use the Hg droplets for the production of the excellent FL lamps for the contribution to the Green Energy Project by UN.

Developmentof prototype of coil-EEFL lamps

We have critically studied the commercial 40W-HCFL lamps. We have found the established technologies of the HCFL lamps are made with the hypotheses without the scientific proofs. The typical hypothesis of the HCFL lamps is the thermo electron emission from the heated BaO particles. The BaO particles never emit the thermo electrons in the vacuum pressures above 1 Pa (10^{-2}Torr).[1–3] The use of the thermo electron emission in the FL lamps is the false story.

We have found that the FL lamps are operated with the coexistence of the disparity of external AC driving circuit and internal DC electric circuit.[1–3] Two disparate circuits are conjugated with the electric field, without the electron flow. The lighting of the FL lamps solely generate with the moving electrons in the internal DC electric circuit. The external driving circuit does not directly involve in the lighting mechanisms of the FL lamp by the injection of the electrons. The external AC driving circuit is only active with the picking-up of the induced AC current from the capacitor C_{Ar}. The formation of the C_{Ar} is a new item for the study on the FL lamps.

We have solved the puzzle on the FL lamps with the science. The Ar gas on the well crystallized phosphor particles in the screen of the FL lamps forms the volume of the glow light under the electric field from the metal electrodes on the outer glass wall of the FL lamps. The external electric circuit never injects the electrons in to the Ar gas space of the FL lamp. Figure 1 shows the photograph of the prototype of the invented coil-EEFL lamp. We will explain the lighting mechanism of the coil-EEFL lamp by the internal DC electric circuit.

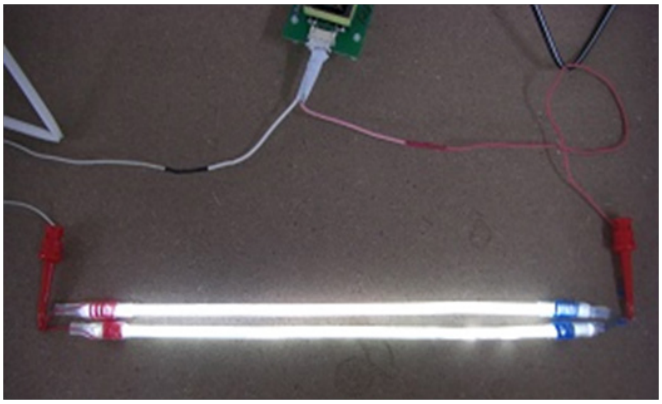

Figure 1 Photopicture of prototype of coil-EEFL lamps in parallel connection. Coil-EEFL lamps are converted from the commercial CCFL lamps

The electrically insulating vacuum between Ar atoms in the volume of the glow light neutralize with the presence of Ar^{1+}. Then the electrons can move on in the volume of the glow light. The accelerated electrons in the volume of the glow light step out from the glow light. The step-out electrons from the volume of the glow light ionize Ar atoms (Ar^{1+}). The electrically insulating vacuum in the FL lamps instantly neutralizes with the moving electrons between cathode and anode with the running speed of the electrons at 10^8 m per second. The neutralized vacuum is surprisingly the superconductive vacuum at the temperatures above the room temperature.[1–3] The complications of the lighting mechanisms of the FL lamps are simply solved by the new findings.

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The next finding is that the electrically neutralized vacuum in the lighted FL lamps provides us the superconductive vacuum at above room temperature. This means the moving electrons in the lighted FL lamps do not have the electric resistance (R). Then, we can calculate the quantum efficiency (η_q) of the Ar* by one moving electrons. The η_q is 10^{16} Ar*$(m^3,s)^{-1}$.[1,2] The FL lamps use Hg* as the origin of the light. The concentrations of Hg atoms in the Ar gas space are 10^{-3} times of Ar atoms. Then, we have the astronomical $\eta_q=10^{13}$ Hg*$(m^3,s)^{-1}$ by one moving electron. The numbers of the moving electrons in the internal DC current in the lighted FL lamps is $3x10^{-4}$ A maximum that contains t $2x10^{15}$ electrons. The lighted 40W-HCFL lamps have the volume is $7x10^{-4}$ m^3. The 40W-HCFL lamps emit $1.4x10^{25}$ visible photons per second. Human eyes adjust the daytime scenery under the slightly overcastting sky that is given by 10^{25} visible photons per $(m^2,s)^{-1}$. We may produce the coil-EEFL lamps in the outer diameter at $3.2x10^{-2}$ m (T-10).

The power consumption of the DC external electric circuit of the coil-EEFL lamps is zero, without a scarification of the illuminance (lm,m^{-2}). The coil-EEFL lamps can be operated with the combination of the solar cells and a battery. This is a great advantage of the coil-EEFL lamps. The invented coil-EEFL lamps may immediately supply the lighting source to the people in the undeveloped countries who are living in the dark night. The coil-EEFL lamps may have a potential of the business by the combination of the generation of the solar-cell panels and agriculture in the developing area without the lines of the distribution of the power supply lines from the power generators.

Here remains the difficulty of the production of the coil-EEFL lamps in the wide diameters. The moving electrons in the vacuum in the FL lamps are seriously influenced with the electric charges on the surface of the phosphor particles in the screens. The moving electrons are electrically repulsed from the electric charges of the surface of the phosphor particles in the screen, generating the gap between the positive column and phosphor screen.[1] The depth of the gap of the commercial HCFL lamps is higher than $3x10^{-3}$ m. The commercial phosphor particles on the world are deliberately contaminated with the surface treatment. We cannot use the commercial phosphor powders for the coil-EEFL lamps. Second problems are the production facilities of the FL lamps. The inside of the vacuum systems of the existing facilities in the laboratories and production lines of the FL lamps heavily contaminated with the oil vapor of the rotary pumps. We must use the oil-less rotary pump for the production of the coil-EEFL lamps. Furthermore, the temperature profiles of the furnaces are too poor. The vacuum sealing process at present is unacceptable. This is the reason that the commercial 40W-HCFL lamps are produced with the wider diameters ($>3x10^2$m) with the gaps deeper than $3x10^{-3}$ m. If the commercial 40W-HCFL lamps are produced with the gap less than $5x10^{-4}$ m, the illuminance will increase to more than 50%. The present production facilities and operation conditions of the HCFL lamps must be changed with the advanced vacuum facilities and operation technologies. Then, you can prepare the reliable coil-EEFL lamps that have the most advanced incandescent lamps.

Conclusion

The invented coil-EEFL lamps have a superior advantage over other incandescent lamps. However, the production of the advanced coil-EEFL lamps requires the advanced phosphor powders, advanced vacuum facilities, and handling of the vacuum facilities. If someone will study on the adequate production facilities and handling them, he may produce the most advanced coil-EEFL lamps that have $W_{DC}=0$ with the high illuminance (>300 lm, m^{-2}) with the operation life longer than 10^6 hours. His results surely contribute to the Green Energy Project by the United Nation.

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None.

Conflict of interest

The author declares no conflict of interest.

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