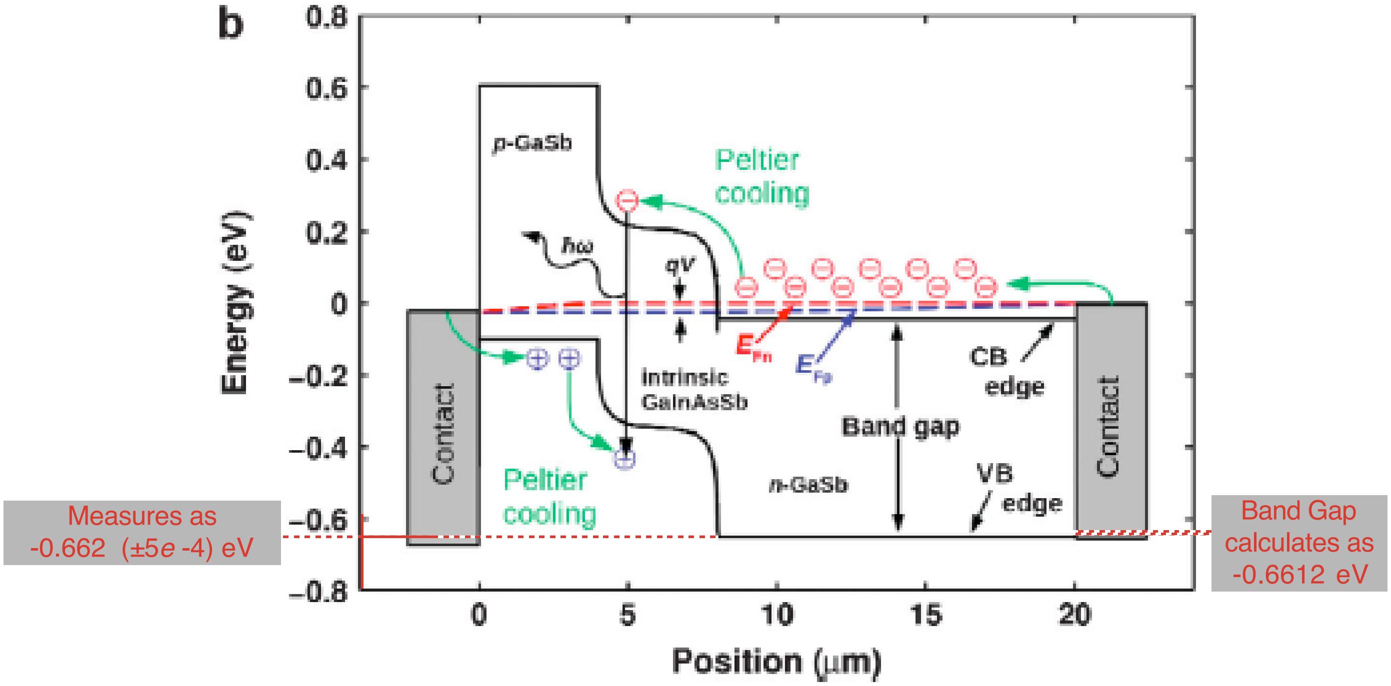
The Quantum Mathematics Governing the Peltier Cooling Band Gap Resistance in MIT's "Over Unity" LED Study

Lawrence Dawson, SRNRL

For a semiconductor,the band gap is defined as the fall from the valence subshell to the conduction subshell. The quantum-dimensional model of the atom accurately calculates the reported band gap from the MIT "over unity" study of a Light Emitting Diode:

MIT Graph[1] showing the Band-Gap Measurement in Comparison to the Calculation for Band-Gap eV using the Quantum-Dimensional Table of Atomic Shell/Subshell Electron Voltages[2]



The Band-gap deficit of "-0.6612 eV" must be made up by electrical power input to allow the electron to fall from the Sb "5f " valence subshell[2] (Antimony from MIT's InGaAsSb diode: 0.9673 eV) to the conduction "4f " subshell (0.3061 eV) . As the amount of electrical energy input falls below light energy output, the power input becomes less efficient in providing the Peltier cooling which is being exchanged for the light emissions. This is true because the single-frequency light emission has a Planck energy which is constant for both higher and lower electrical power input levels. The time of discharge of the higher energy light emission must increase relative to electrical input, reducing light emission wattage. For electrical power inputs below equivalence with light energy (but prior to thermal radiance entanglement below the Hoffman thermal radiance output level), the light power output is reduced by an average of 20.73% relative to input for every drop in an exponential unit of electrical power input. This common inclination away from output-to-input efficiency is significantly altered by thermal radiance entanglement.

The band gap represents a *Negative Capacitance Field* with excess energy which must be removed by the nucleus in order to allow an electron to fall into the conductance subshell.

The Sb "5f" valence subshell has a capacitance field with an excess of "0.6612 eV" relative to the capacitance field of the "4f" subshell along which all electrical conduction occurs. For the semiconductor to be facilitated so that it may carry an electrical current, a large fraction of "0.6612 eV" must be subtracted from the electron voltage of the "5f" valence electron subshell.

[1] PhysRevLett.108.097403, p. 097403-2. As annotated by the SRNRL.

[2] See the Quantum-Dimensional Periodic Table of Elements. *Four Dimensional Atomic Structure.* Tab 10. Paradigm Publishing, 2013.

By the Curie symmetry principle[3], the valence electron capacitance field is a projection of the nuclear magnetic current. The energy being stored in this capacitance field is from nuclear heat energy (proton spin) which is associated with the magnetic current heat signature. The nucleus can reduce the electron voltage by the required fraction of "-0.6612 eV" by removing some of this heat energy being stored in the valence subshell capacitance field. Reducing heat-energy storage in the field allows the valence electron to fall to the conductance subshell electron voltage which, in turn, initiates an electric current flow.

Peltier cooling adjusts valence subshell electron voltage to allow conduction to occur.
In order to subtract heat energy from the valence subshell capacitance field, the nucleus must exchange this heat for a light emission at the LED frequency (MIT's approximately 2.15µm[4] wavelength or a frequency of 1.394384*e*14 Hertz). Similar to negative radiation, the nucleus gives up temperature by investing the energy in a light emission.[5] The energy exchanged for the light emission by Peltier cooling is equal to the Planck energy value of the light emission:

$$\{Energy\ given\ up\ by\ Peltier\ cooling\} = \{Light\ emission\ energy\} = E$$

$h =$ Planck's Constant; $f =$ light frequency;

$n =$ number electron oscillators ⟨from Planck's original formulation⟩ [6]

$$E = nf(h) = n(1394384e14\ Hertz)(6.6260755e\text{-}34\ joules) = n9.2392905165e\text{-}20\ joules$$

$$\{given\ up\ eV\ per\ valence\ electron\} = \frac{(1)f(h)}{elementary\ charge} = 0.5766709055\ eV$$

$$\{resultant\ eV\ from\ loss\} = (valence\ subshell\ eV) - (given\ up\ eV) = 0.9673 - 0.57667$$
$$= 0.39063\ eV$$

$$\{variance\ between\ cooling\ resultant\ eV\ and\ conduction\ eV\} = 0.39063 - 0.3061 = 0.08453\ eV$$

Notice that the Peltier cooling exchange of nuclear heat for light emission, when expressed by the conventional electron voltage formula (E/ *e* =0.5767 eV), is less than the required electron voltage drop across the band gap (0.6612 eV). How can the electron drop from the Sb "5f" valence subshell to the "4f" electrical conduction subshell if not enough electron voltage has been removed from the capacitance field to facilitate the transfer? The answer is found in the unique characteristics of the atomic capacitance field.

As predicted by Pierre Curie[7] , the nuclear magnetic current provides a heat signature and projects an electrical capacitance field in symmetry to an electric current which is known to project a magnetic field. Although any capacitance field stores energy, the unique characteristic of the atomic capacitance field projected by the nuclear magnetic current is that the stored energy is the heat signature of the magnetic current. It is not the conventional electrical energy storage which is defined as *"voltage times charge."* Because the atomic capacitance field stores the nuclear heat signature, the electrical components of the field energy can be adjusted.

Specifically, the heat energy stored can be greater than the field energy as defined by the subshell's electron voltage *times* the elementary charge of the electron (field E> eV•*e).* Because the electron voltage of any valence subshell is fixed and because the energy stored in the capacitance field can be

[3] See *Four Dimensional Atomic Structure; Tab 3,* p.p. 12-15. Op. cit.

[4] PhysRevLett.108.097403, p. 097403-2A.

[5] *The Discovery and Measurement of Black Light as Negative Radiation,* Dawson, Lawrence SRNRL. Available at: http://www.paradigmphysics.com/N-radiationstudy.pdf

[6] Planck energy is "per electron" light energy. The quantum dimensional orbital model can derived Planck's constant as the energy of electron spin within the orbital. See *"The Derivation of Planck's Constant from Dawson's Tensor,"* Tab 6, *Four Dimensional Atomic Structure.* Op. Cit.

[7] See *Four Dimensional Atomic Structure; Tab 3:. p.p. 12-13* for a translation of Curie's article predicting and describing magnetic conductibility and free magnetism. Op. Cit.

greater than the electron's elementary charge *times* this subshell eV, the field can actually posses a greater charge value than provided by the subshell's electrons.

There is experimental data demonstrating that heat storage in an atomic capacitance field can provide an excess field charge[8] . For the Peltier cooled LED, the subtraction of heat energy to allow an electron drop into the conduction "4f" subshell does not require removal of all heat energy between that required by the "5f" subshell and that required by the "4f." Excess heat energy remaindered in the conduction "4f" can provide an excess field charge.

The Peltier cooling to LED light emission, as converted to field electrical values, is actually the following:

$$e = \{elementary\ charge\} = 1.60217733e\text{-}19\ coulombs$$

$$\{\text{"}5f\text{"}\ valence\ subshell\ electrical\ energy\} = (0.9673\ eV)e$$

$$= 1.5497861313e\text{-}19\ joules$$

$$\{Cooling\ reduction\ of\ valence\ field\ energy\} = (1.5497861313e\text{-}19\ joules) - \left(\frac{c}{2.15\ \mu\text{m}}h\right)$$

$$= 6.2585707966e\text{-}20 = (0.39063\ eV)e$$

CORRECTED TO CONDUCTION "4f" SUBSHELL

$$(0.39063\ eV)e = (\text{"}4f\text{"}\ eV)1.276e = (0.3061\ eV)1.276e \qquad \langle\text{excess charge remaindered}\rangle$$

Cooling Reduction of Field Energy remainders a higher Charge for the Conduction Subshell

The removal of heat energy from the "5f" subshell's field via the light emission reduces the electrical energy definition of the field and,therefore, reduces the potential electron voltage of the orbital. However, all potential orbitals are quantum values defined by the fixed orbital shell/subshell structure. "0,39063 eV" is between the "4d" subshell's "0.4723 eV;" (the valence subshell of the "Ga" and "As" components) and the next lower conduction "4f" subshell at "0.3063 eV."[9]

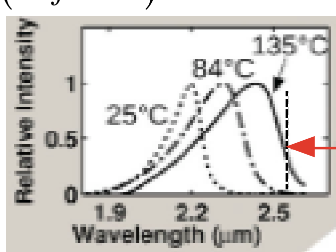
The heat energy reduction would provide an insufficient charge value in the "4d" subshell at "0.827*e* ." Therefore, the reduction of heat field energy must cause the electron to fall from the Sb valence "5f" to the conduction "4f " with its excess charge value of "1.276*e*." The excess charge provides the "4f" with increased efficiency and assures the electrical current flow by the fall between the "5f" and the "4f."

The light emission wavelength must be limited by the following:

$$upper\ limit:\ (\text{"}5f\text{"}\ eV) - (\text{"}4d\text{"}\ eV) = 0.9673 - 0.4723 = 0.495\ eV; \qquad \lambda = 2.50\ \mu m$$

$$lower\ limit:\ (\text{"}5f\text{"}\ eV) - (\text{"}4f\text{"}\ eV) = 0.9673 - 0.3061 = 0.6612\ eV; \qquad \lambda = 1.88\ \mu m$$

MIT's LED Light Emission Curves Conform to Quantum Predicted Limits[3]



Effect of "stretching" band-gap electron voltage by 135° thermal radiance entanglement

Excess charge in the conductance subshell facilitates diode current flow when electrical field energy falls

[8] For a description of the experimental data see the SRNRL video *"Part II: The Discovery of an Alterable Nuclear Energy Field."* Available on YouTube at: *http://www.youtube.com/watch?annotation_id=annotation_59973&feature=iv&src_vid=ArLRKvwy4_8&v=PXUohP67mzA*

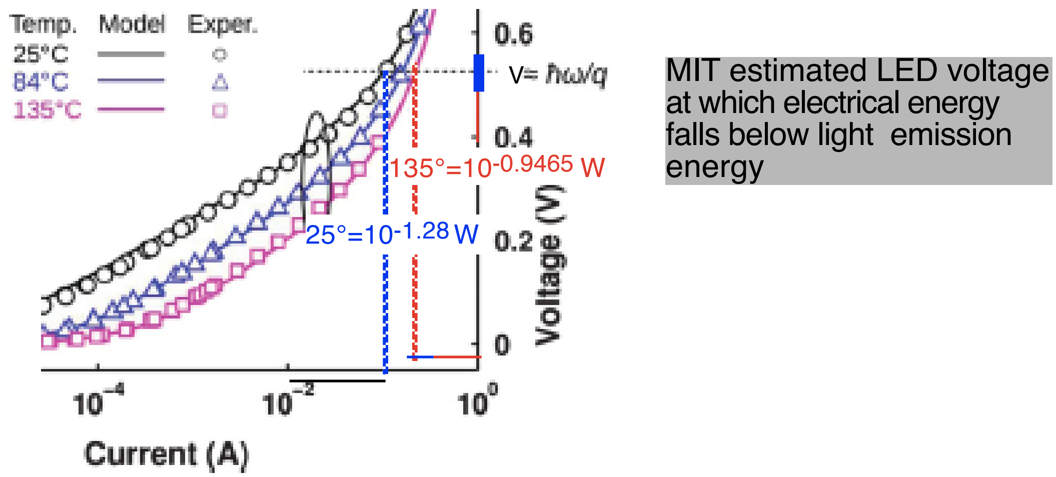
[9] See the Quantum Periodic Table for the valence subshells of elements. *Four Dimensional Atomic Structure.* Tab 10. Paradigm Publishing, 2013.

below subtracted light energy. Electrical energy, defined as voltage *times* charge, is descriptive of the diode's circuit and current flow. It is this energy which must be invested in the band-gap capacitance field to stimulate the light emission being exchanged for cooling. The lowering of field energy via cooling initiates an electron fall from the valence subshell to the conduction subshell.

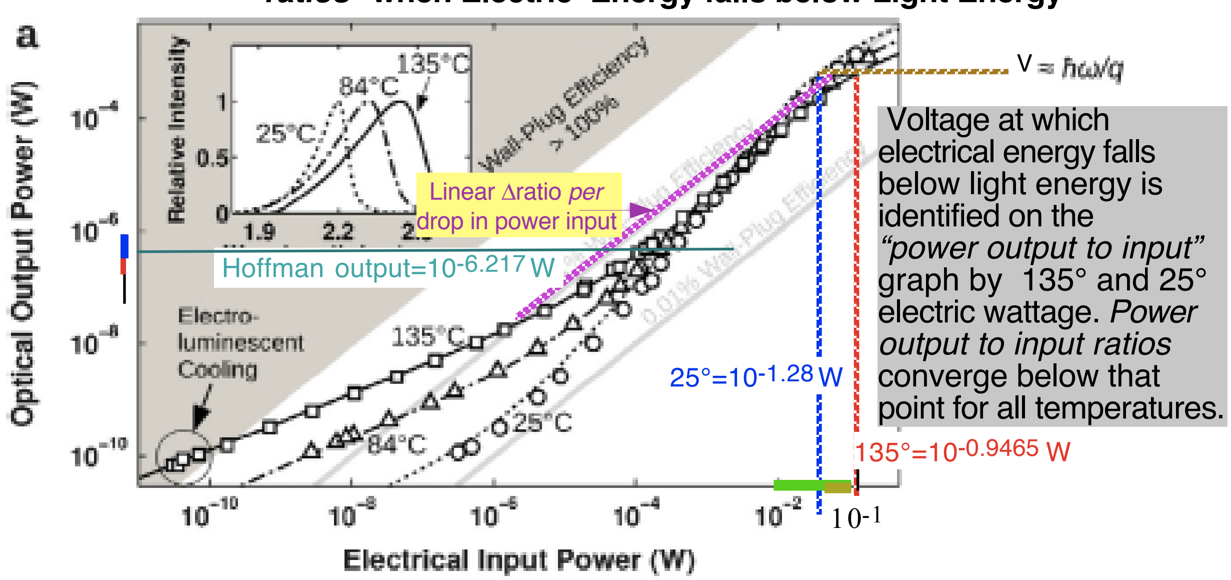
Electrical energy which is lower than the emitted light energy can still stimulate the required cooling/ light-emission reaction. This is true because of the excess charge value which is supplied the conductance subshell by the field energy removal. Due to the excess charge value, electrical conductance is more efficient than continuing to station the electron in the valence subshell. That is, conductance is more efficient than "non conductance."

MIT Graphs[10] showing the Effects of Electrical Energy falling below Light Energy

MIT Fig. 2 (annotated): **Temperature Divergence in Electrical Power Input (from Resistance) when Electric Energy falls below Light Energy**



MIT Fig. 1-a (annotated): **Temperature Convergence in *"Power Output to Power Input ratios"* when Electric Energy falls below Light Energy**



When electric energy falls below LED light energy, the various temperatures diverge in diode wattage output but converge towards a common *"power output to power input ratio."* This convergence

[10] PhysRevLett.108.097403, p. 097403-2 Fig. 2 and Fig. 1-a

towards a common *"power output to power input ratio"* for all diode temperatures continues until electrical power input drops to the point at which the Hoffman nuclear thermal radiance power output entangles LED light power output. Below Hoffman, the output to input ratios for the various temperatures begin to diverge again.

The zone of convergence in *"output to input ratios"* for all measured temperatures occurs between the point of light/electrical energy equivalence (input approximately $10^{-1.025}$ W) and the Hoffman thermal radiant power output entanglement with light power output ($10^{-6.217}$ W). This non-divergence zone of temperature-equivalent output-to-input ratios is not accidental.

Field Resistance vs. Circuit Resistance

The drop of an electron from the Sb "5f" valence subshell to the "4f" conduction subshell across the band gap represents a change in the capacitance fields governing electron orbitals. Specifically, energy is removed from the electron's capacitance by Peltier cooling being exchanged for the light emission. The time required to remove the energy from the field represents a capacitance discharge. The time of this discharge determines the wattage output of the light energy:

$$\{Field\ Energy\ removal\} = \{light\ emission\ energy\} = n(f)(h)$$

$$\{\text{time of field energy discharge}\} = t = \{time\ determining\ light\ wattage\}$$

$$P_{\text{light}} = \frac{E}{t} = \frac{n(f)(h)}{t}$$

$$\{\text{discharge time of a capacitance field}\} = t = C(R)$$

The standard formula for capacitance field discharge time is:

(Capacitance)(Resistance) = Discharge Time

However, the above discharge time does not represent the total discharge of the energy stored in the field, as it does with a normal capacitor. Rather, the "discharge time" lowers the energy of the field to the new capacitance energy storage requirement of the lower "4f" subshell. The number of electrons "n" required to emit the LED light at the prescribed energy level are discharging their energy over the period "t." "Energy/ t" is the definition of power or wattage. Unlike the standard capacitor which completely discharges field energy over "t," band-gap field energy is continuously discharging over units of "t." as long as electrical current is maintained and this discharge time establishes the wattage output of the light emission.

"Discharge time" is a function of capacitance and resistance, but the resistance is not that of the circuit. We know this because the circuit resistances of the different temperatures begin to diverge as current energy input falls below light energy output. However, below light/electrical energy equivalence, temperatures converge in power output to power input ratios. Circuit resistances vary by temperature but power output to input ratios do not. Changes in this temperature-common ratio is function of changes in time of discharge which, itself, is a function of a field resistance as indicated by the standard capacitance formula. The formula is the following:

$$P_{\text{light}} = \frac{E}{t} = \frac{n(f)(h)}{t}$$

$$t = C(R_{\text{field}})$$

We know how this resistance is changing as electrical input energy falls below light output energy. Statistical analysis of the MIT data graphs has revealed it. Below electrical-light energy equivalence but prior to thermal radiance entanglement below Hoffman, the light power output is reduced relative to electrical power input by an average of 20.73% for every drop in a unit of power input. All temperatures are inclining away from "wall plug efficiency" by 20.73% per drop in an exponent of electrical power input. The discharge time factor is increasing by 4.824 *times* for every drop in an exponential unit of electrical input. This increase in discharge time is due to changes in capacitance and field resistance by standard formula.

Formulas for Band-Gap Capacitance and Field Resistance

$$\{subshell\ electron\ capacitance\} = eC_{sbshl} = \frac{(elementary\ charge)}{(subshell\ electron\ voltage)} = \frac{e}{eV_{sbshl}}$$

$$\{\text{"}5f\text{"}\ electron\ capacitance\} = eC_{5f} = \frac{1.60217733e-19\ coulombs}{0.9673\ eV} = 1.6563396361e-19\ eF$$

$$\{Band-gap\ capacitance\} = W_{in}(eC_{5f}); \qquad W_{In}(eC_{5f})R_{fld} = t_{dschrg}$$

$$let\ W_2 = 10^{-1}W_1; \qquad \frac{W_2(eC_{5f})R_2}{W_1(eC_{5f})R_1} = \frac{4.824\,t_1}{t_1}; \qquad \frac{0.1R_2}{R_1} = \frac{4.824}{1}$$

$$\frac{R_2}{R_1} = \frac{48.24}{1}; \qquad \left\langle \begin{array}{l}\text{The drop of one exponential unit in wattage input}\\ \text{increases band-gap resistance by 48.24 times.}\end{array}\right\rangle$$

Explanation of Formulas

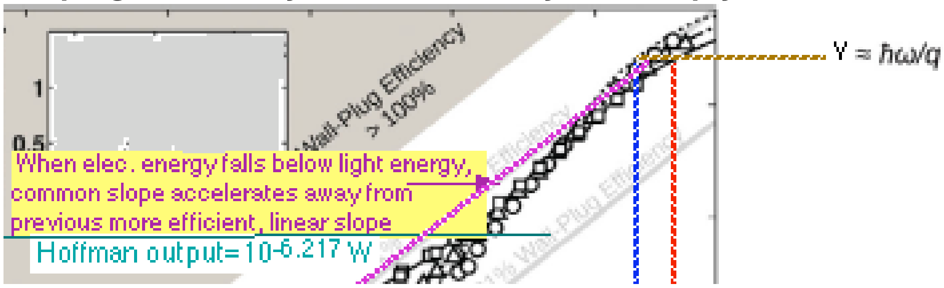
Because each orbital subshell has an exact electron voltage,[11] the capacitance per electron staged in any subshell can be calculated by the standard formula "capacitance *equals* charge *divided by* voltage." The formula for electron capacitance (eC) is "eC=(elementary charge)/ (subshell electron voltage)." Band-gap capacitance is the eC of the "5f" subshell *times* the wattage of the electrons streaming across the band gap from the "5f" valence subshell to the "4f" conductance subshell. Wattage, rather than amperage, is used to determine band-gap capacitance because the electron stream is motivated by a separate voltage and not the subshell's electron voltage.

The energy discharged from the band-gap capacitance field is the energy of Peltier cooling which is being exchanged for the light emission. The energy of the light emission is a measure of the field energy discharged and the time of discharge determines the wattage output of the light emission by the standard formula "Wattage=Energy/ time." The time of discharge is established by the capacitance formula "C(R)=t" where "R" is field resistance, not circuit resistance.

When electrical energy input falls below light energy output, the time of discharge must increase significantly to compensate for lower electrical energy input. A secondary statistical analysis of the MIT data determines that the time of discharge increase by 4.824 *times* for every drop in an exponential unit of electrical power input. The formula for band-gap capacitance, field resistance and discharge time demonstrates that this increase in discharge time per unit of drop translates into a field resistance increase of 48.24 *times* for every drop in an exponential unit of power input below the light to electrical energy equality.

The MIT data graph identifies this change in field resistance. Above the equality, the light output to light input ratio tends to be linear and more efficient. Below the equality, the slope of the line accelerates away from this linear and efficient slope indicating accelerating change in field resistance.

MIT data graph[12] shows all temperatures enter sub-light-energy zone at shallower slopes of greater "wall plug" efficiency from which they fall steeply towards less efficiency



[11] See *"Table of Shell / Subshell Electron Voltages"* in *Four Dimensional Atomic Structure.* Tab 10. Op. cit.

[12] PhysRevLett.108.097403, p. 097403-2 Fig. 1-a

Calculating LIght-Energy Output using Voltage Equality from MIT Data

$$E = V(A)\sec. = n\frac{c}{2.15\ \mu m}h = (0.525\ V)(0.134\ Amp)\sec. = 0.07033\ Watt\ \sec. = 0.07033\ joules$$

$$0.07033\ joules = n(139438352558140\ Hertz)(6.6260755e-34\ joules)$$

$$= n(9.2392905165e-20\ joules)$$

$$n = \frac{0.07033}{9.2392905165e-20} = 7.612171646e17\ electron\ oscillators$$

output of 2.15 μm light wavelength is by the "4p" subshell

$$\frac{1}{\{wavelength\ of\ "4p"\ subshell\}} = \left(\frac{1}{4^2} - \frac{1}{7^2}\right)\frac{1}{91.143\ nm} = \frac{1}{2.165\ \mu m}$$

"4p" subshell contains 4 electrons and is only available to "Sb" component of the diode amalgam

$$\{number\ of\ atoms\ required\ for\ emission\} = \frac{n}{4} = \frac{7.612171646e17}{4} = 1.9030429115e17\ atoms$$

$$\{atoms\ as\ \%\ of\ a\ mole\} = \left(\frac{1.9030429115e17}{Avogadro = 6.0221367e23}\right) = 3.1600792315e-7$$

$$\{grams\ in\ a\ mole\ of\ "Sb"\} = 121.76\ grams;$$

$$\{required\ material\ for\ light\ energy\ emission\} = (121.76\ grams)(3.1600792315e-7)$$

$$= 38.8477\ \mu g \qquad \langle micro\ grams\ of\ Sb\rangle$$