Generation of Homogeneous Discharge Plasma at Atmospheric Pressure

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A new Barrier Discharge System Using Dielectrics with Uniformly-Distributed Metal Pieces Inside, which makes it possible to control the distribution of electrons charged up on the surface of dielectrics.
The new DBD device was evolutionarily designed after the Capacity-Coupled Multi-Discharge, CCMD.

Typical DBD Configurations

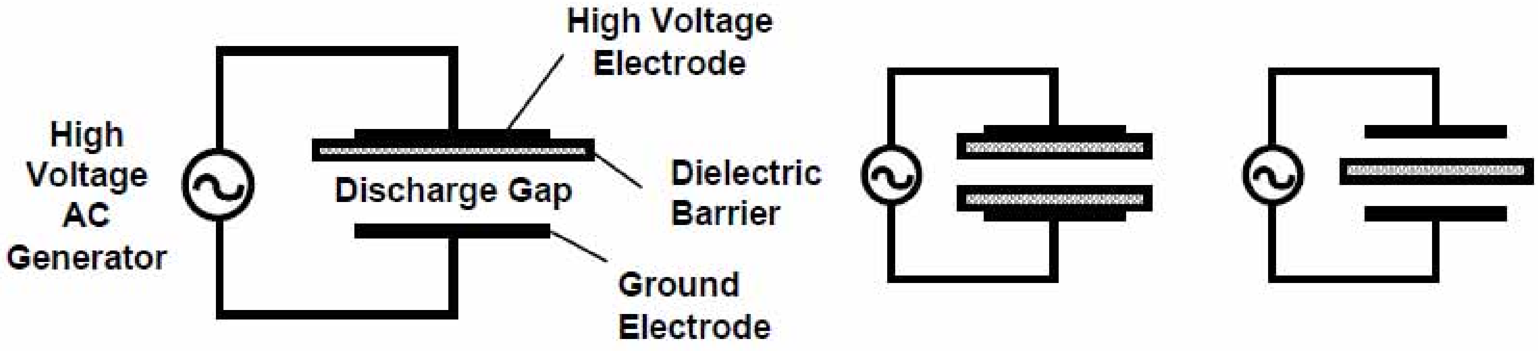
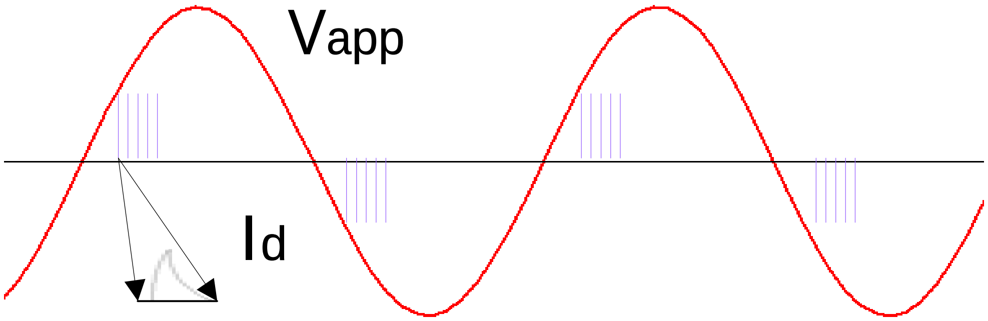
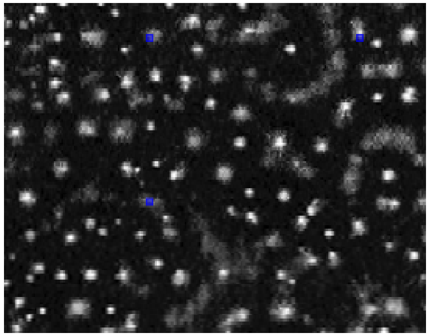


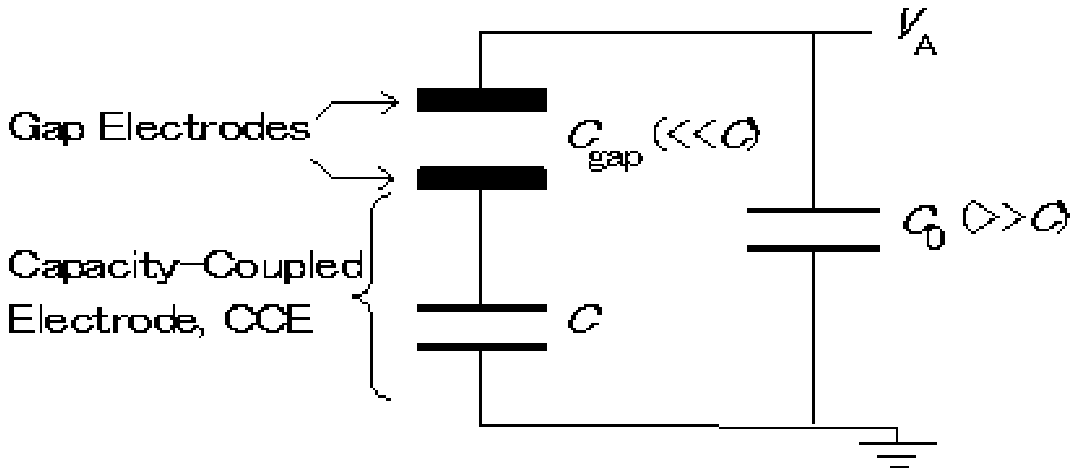
Fig. 1: Typical barrier discharge configurations

Relationship between applied voltage and discharge current & Lichtenberg figures for barrier discharge



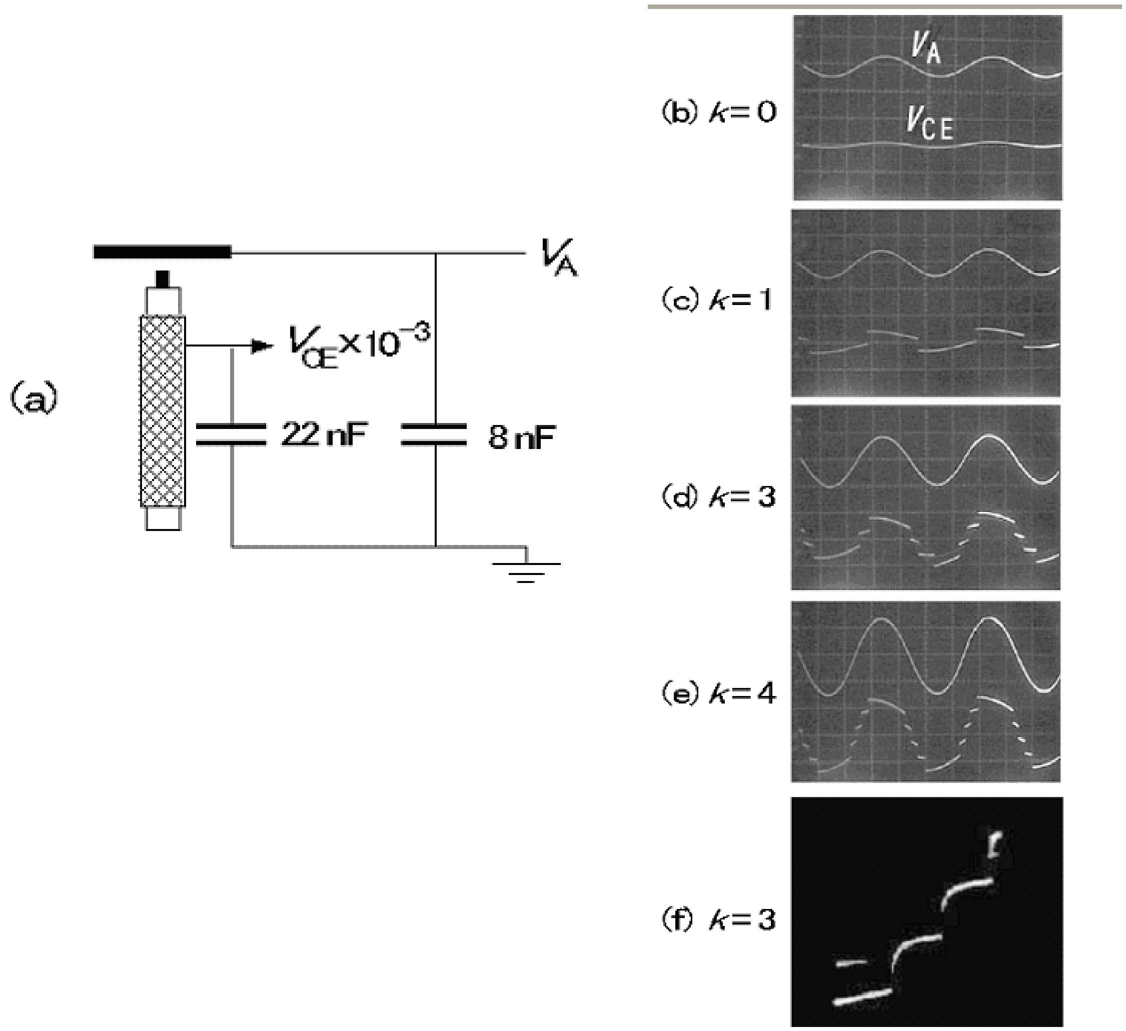


Capacity-Coupled Diode Discharge

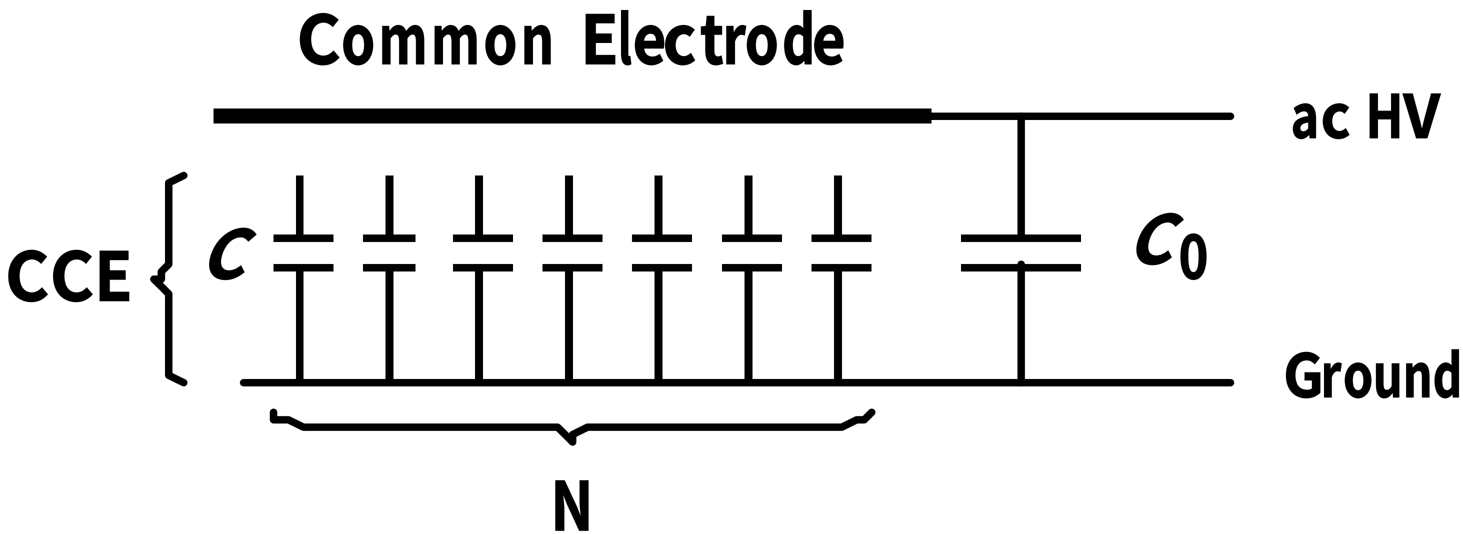


Energy consumption for dicharge $w \sim \frac{1}{2} C V_A^2$

Typical Characteristics of Capacity-Couped Diode Discharge

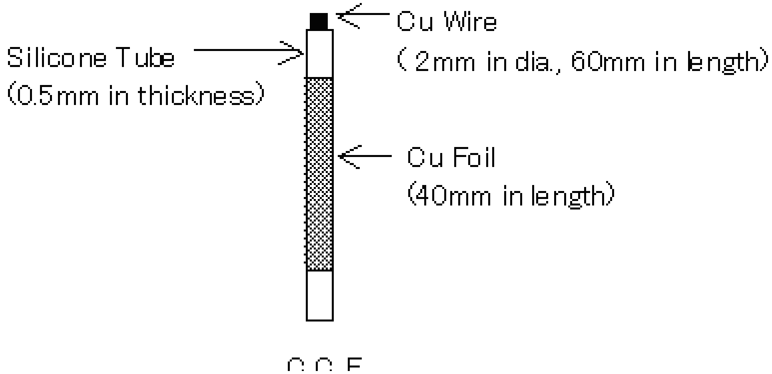


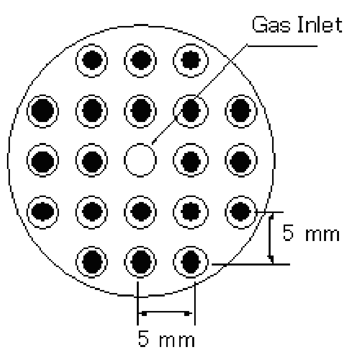
Basic Concept of CCMD device

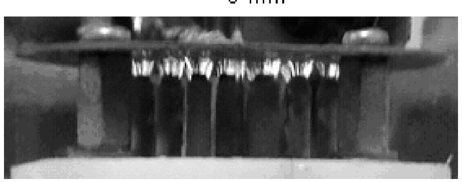


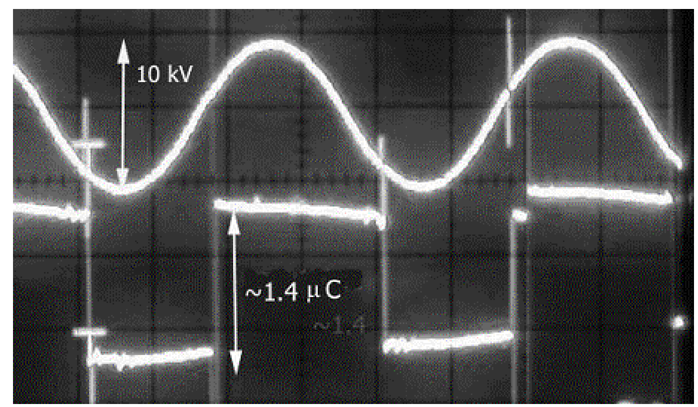
C_0 is larger than sum NC of the capacitance C of CCE.
N: number of CCE

20 CCE CCMD devoce









Total amount of transferred charge, 20Q ,

Notice

V-I waveform for Atmospheric Pressure Glow Discharge APGD

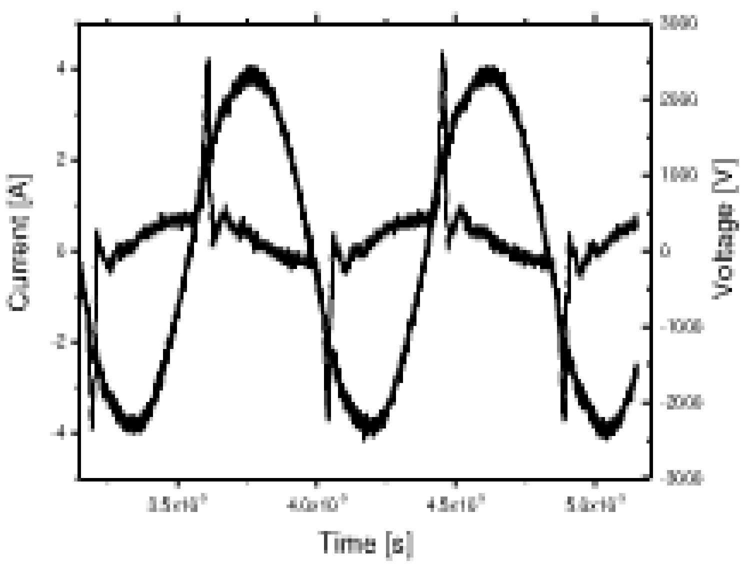
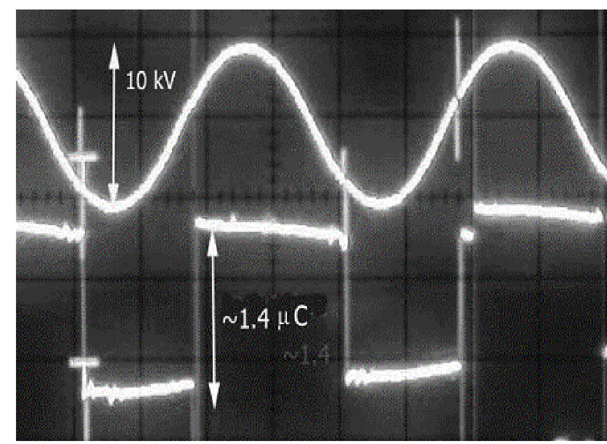
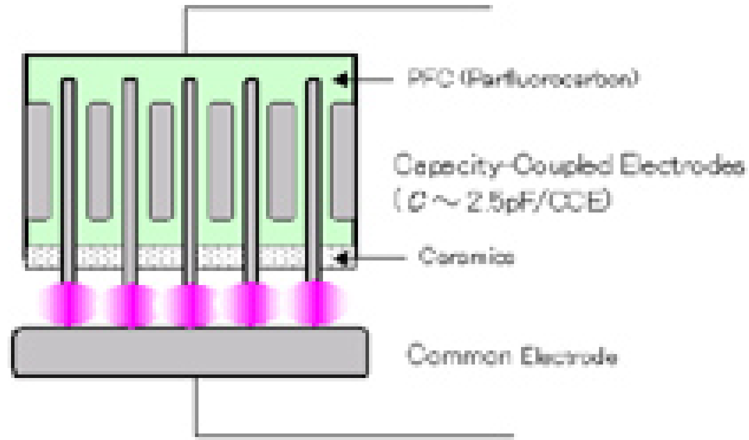


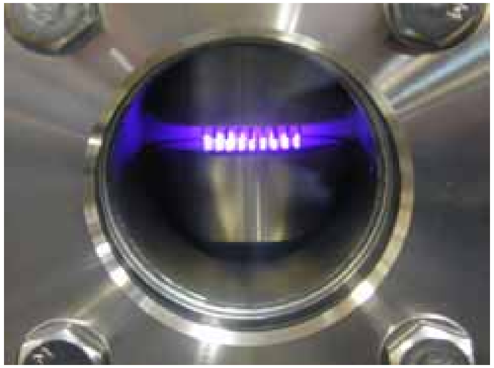
Figure 2. Voltage-current waveforms for APGD in air

V-Q waveform for 20 filamentary discharges

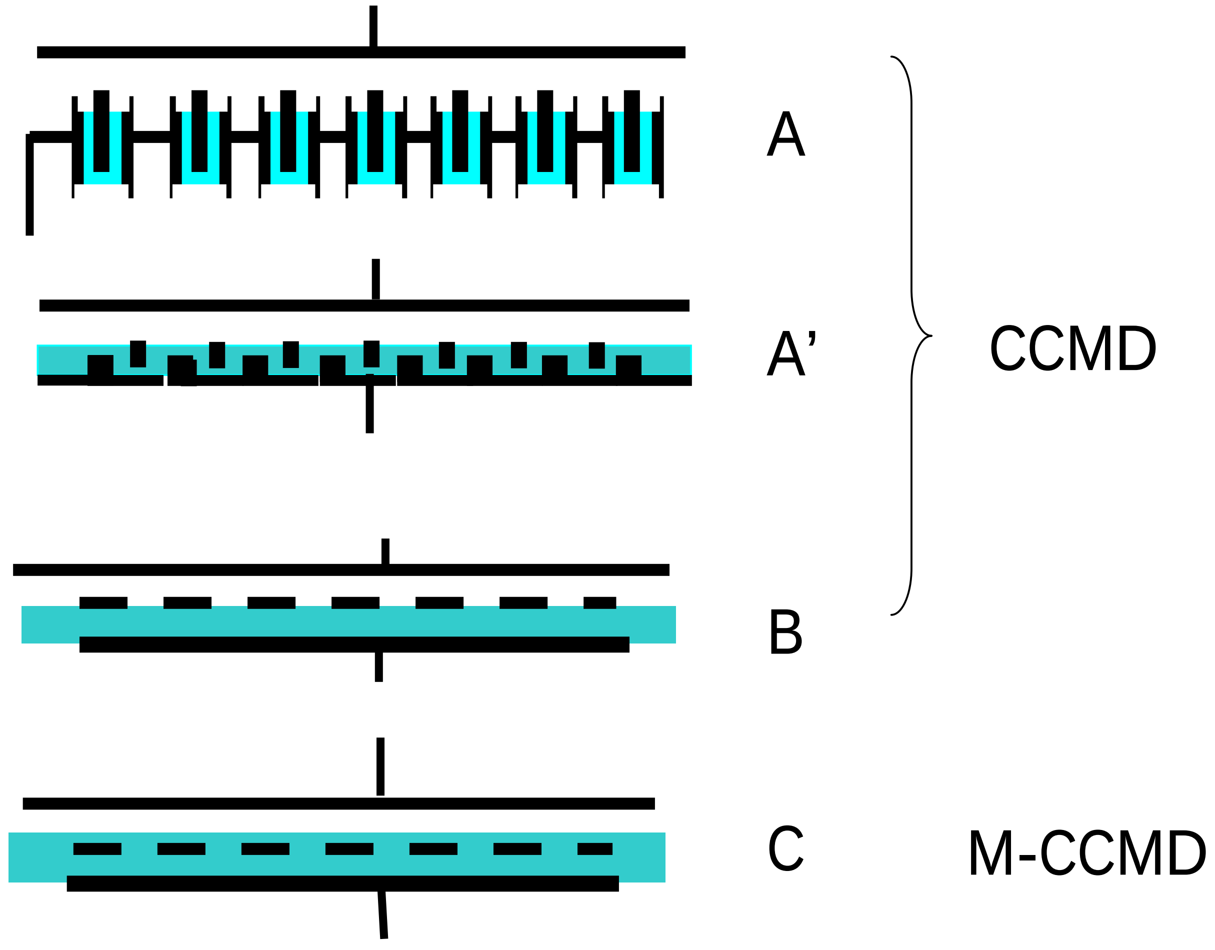


18 CCE CCMD device using hermetically sealed connector and light emission

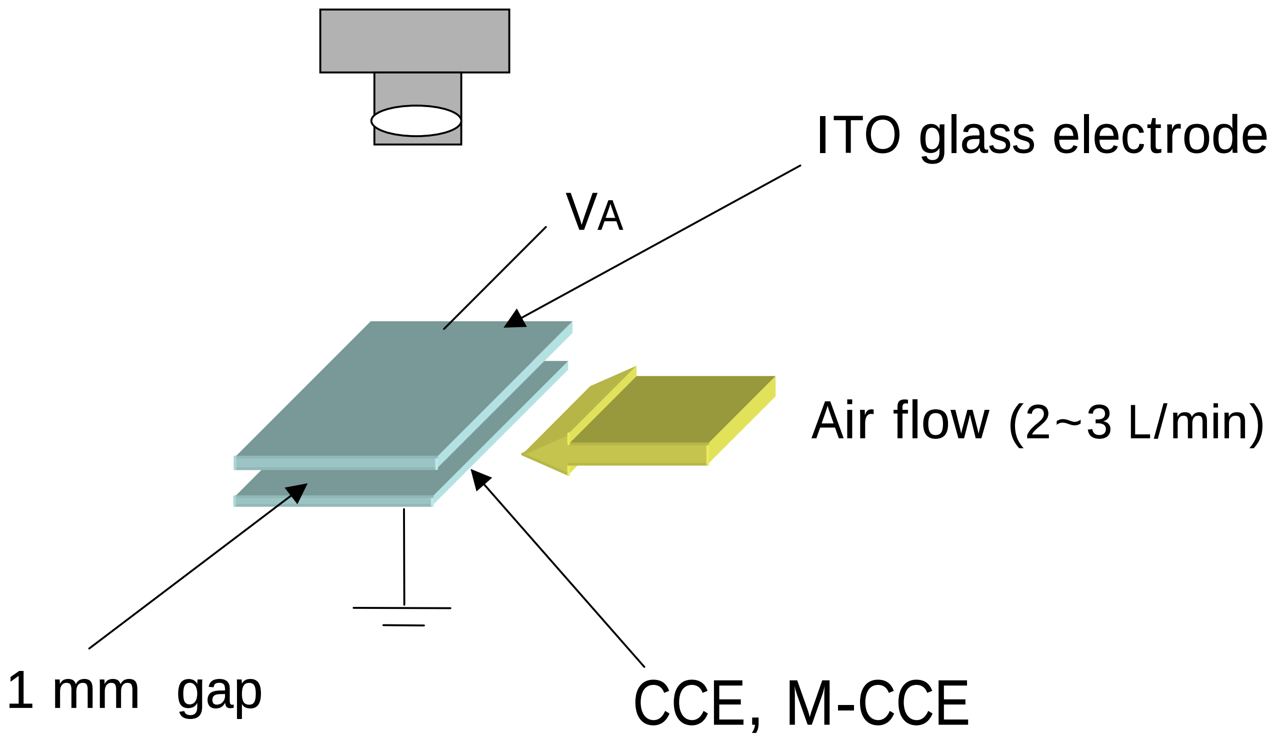




Variations of CCE structure

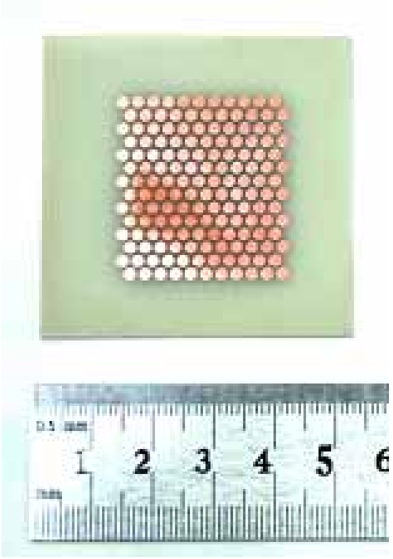


Observation of light emission from CCMD and M-CCMD

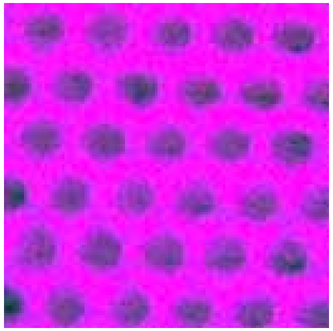


Light emission from.CCMD and M-CCMD

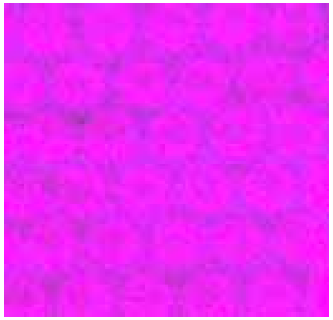
metal patches
on glass epoxy substrate
2 mmφ., 2.5 mm pitch



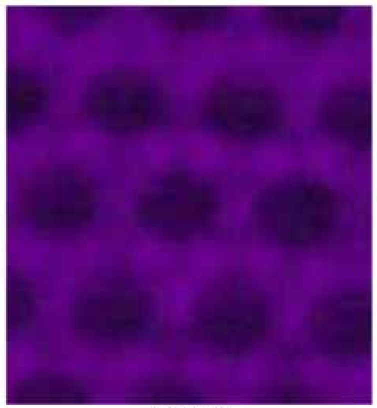
CCMD



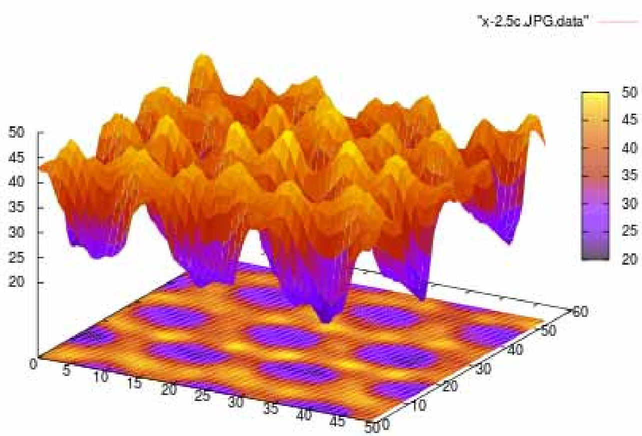
M-CCMD
metal patches are covered by Kapton film



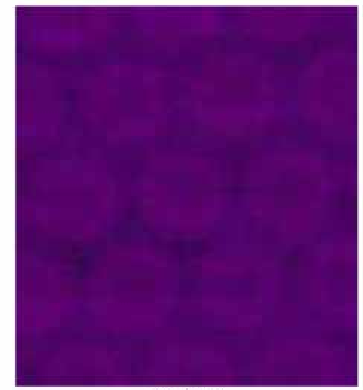
Intensified Display of Light Emission Patterns from CCMD and M-CCMD



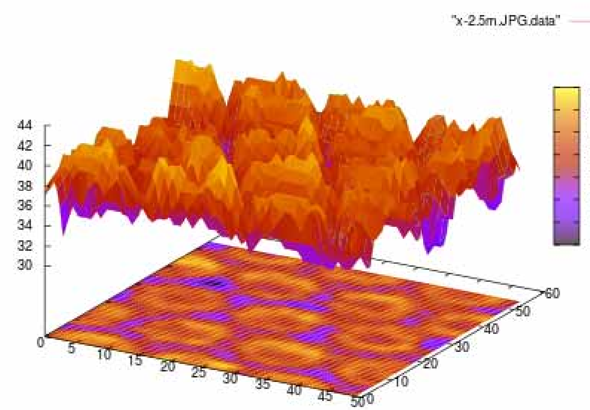
x-2. 5c. JPG



x- 2. 5c. J PG dat a

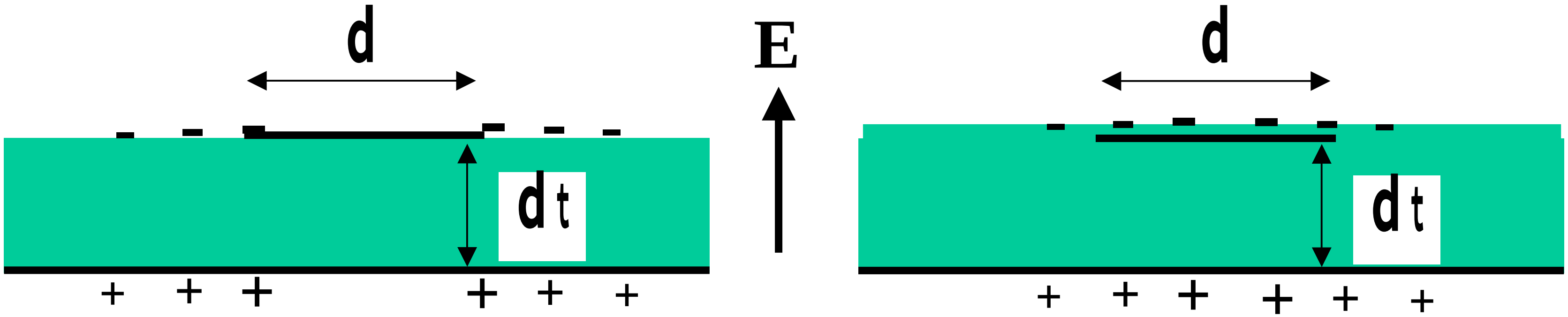


x-2. 5m JPG



x- 2. 5m J PG dat a

Patch電極および誘電体表面の電子による帯電

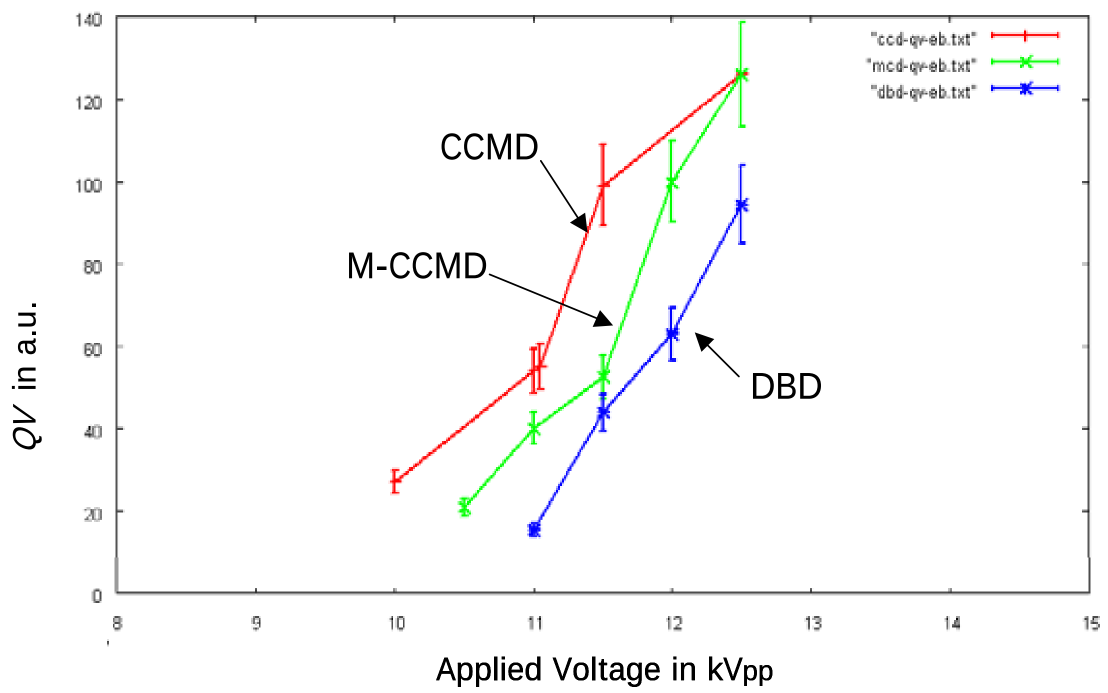


Patch電極が誘電体膜で覆われていない場合，Patch電極の形状が誘電体の厚さに比べて極端に大きくない場合は,平行平板コンデンサーとはみなせなくなる．したがって,電極上の帯電粒子はクーロン斥力によりPatch電極端に分布し,そこに強い歪電場が発生する．この歪電場により容易に沿面放電が引き起こされると思われる．沿面放電によって発生した荷電粒子は誘電体表面に帯電する．これらの帯電粒子は通常のDBDと同じ働きをする． Patch電極の役割はDBDのトリガーといってもよいだろう．Patch電極中心には放電破壊のための初期電子が分布できないため,そこには放電発光が見られない．

Patch電極が誘電体膜で覆われている場合，帯電粒子は移動することが出来ないので, Patch電極上の誘電体膜に分布する． したがって発光が見られようになる．

Deposited Energy vs. Applied Voltage In CCMD, M-CCMD and simple DBD.

electrode 2cmx5cm, 2mmf 4mm pitch

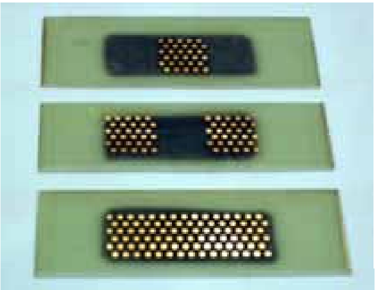


Effect of floating electrodes, Incremental energy deposit for simple DBD

Powered electrode : 2 cm x 5 cm,

Floating electrodes : 2 mm ϕ, 4 mm pitch

dielectrics thickness : 1 mm and 1.6 mm



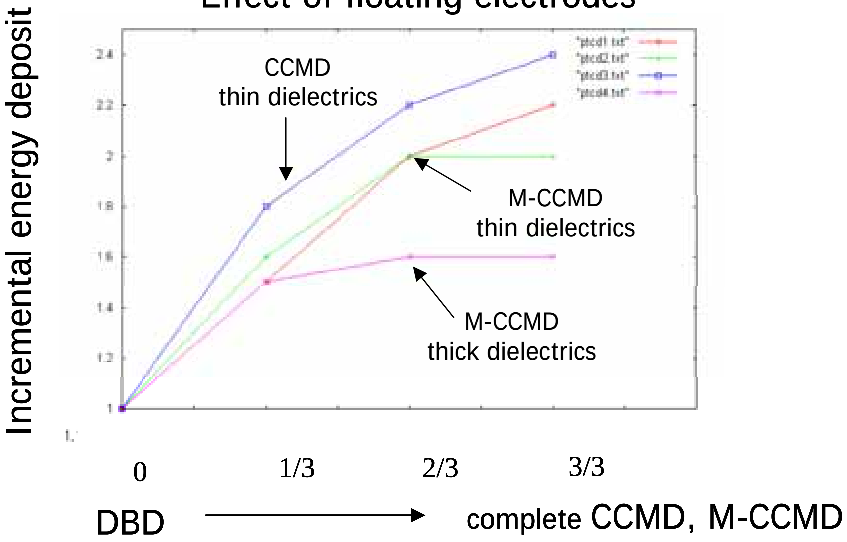
1/3 partial CCMD

2/3 partial CCMD

3/3 complete CCMD

M-CCMD electrodes are covered with Kapton film

Effect of floating electrodes

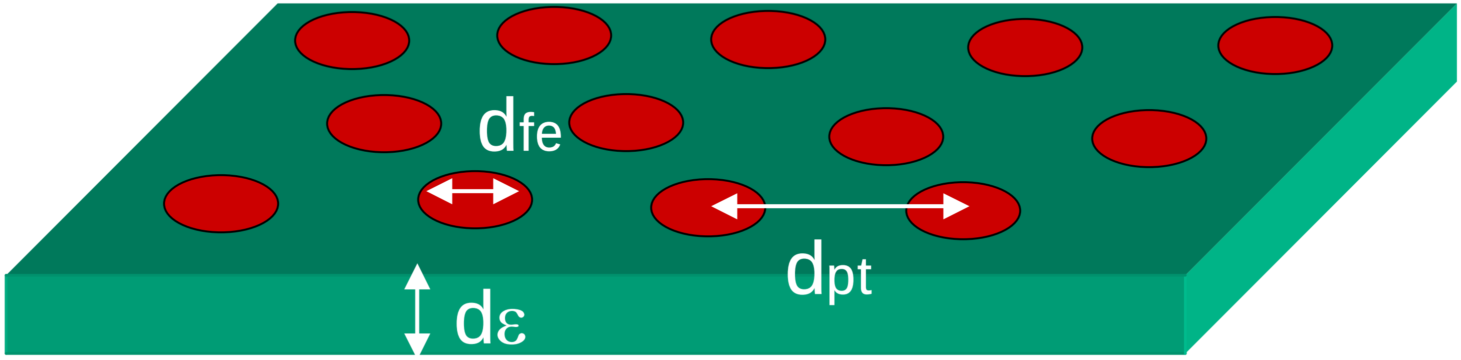


patch電極の大小,粗密の影響

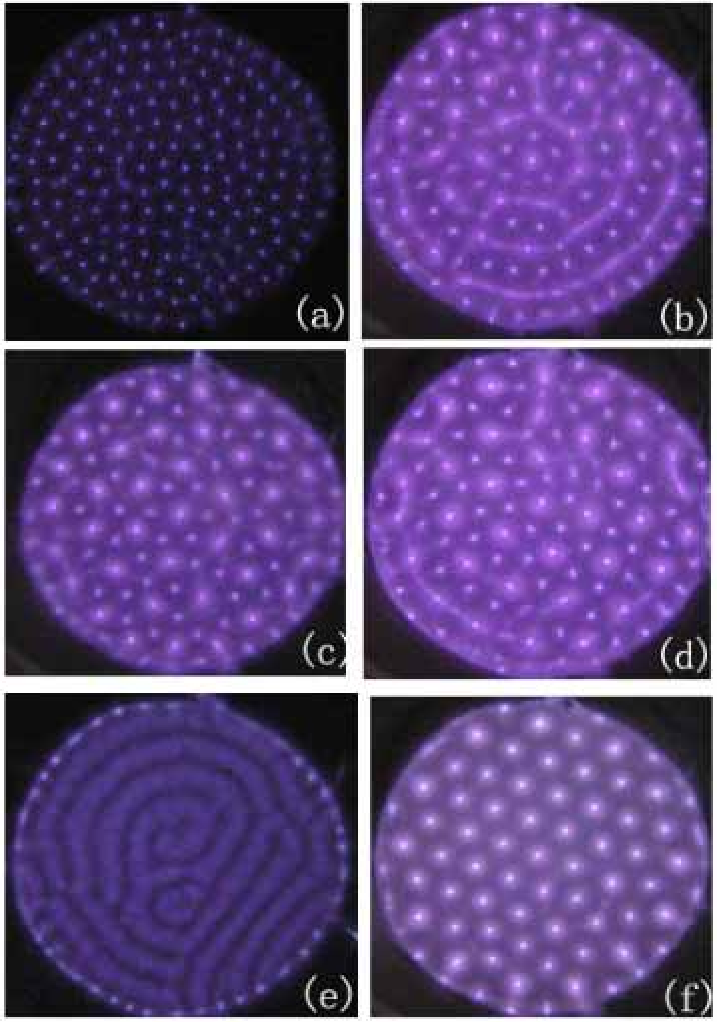
放電特性を支配するaspect

d_{fe}/d_{ε}　浮遊電極上の電荷分布，電場の端効果

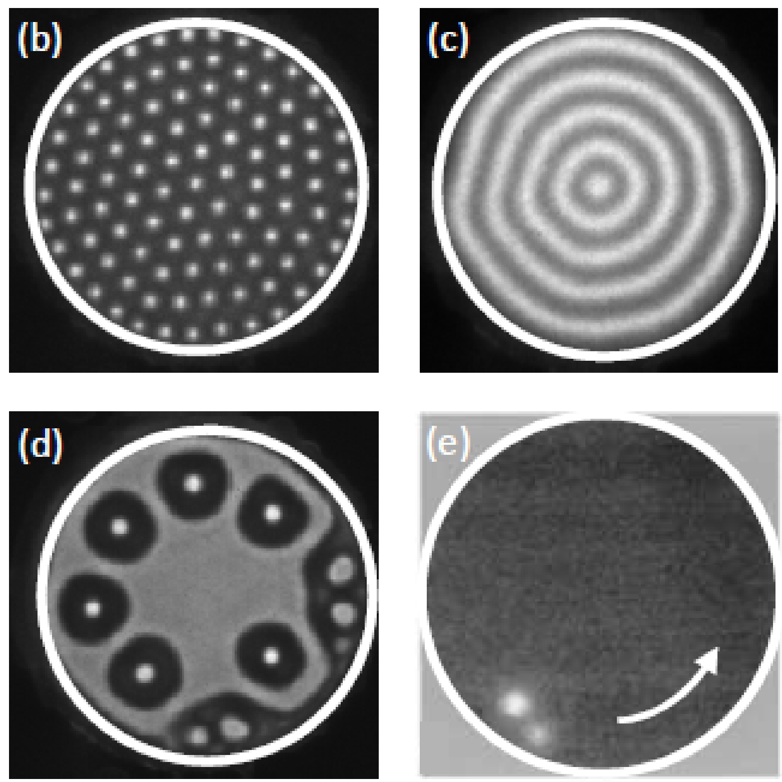
d_{pt}/d_{fe}, d_{pt}/d_{ε}　誘電体表面の蓄積電荷分布



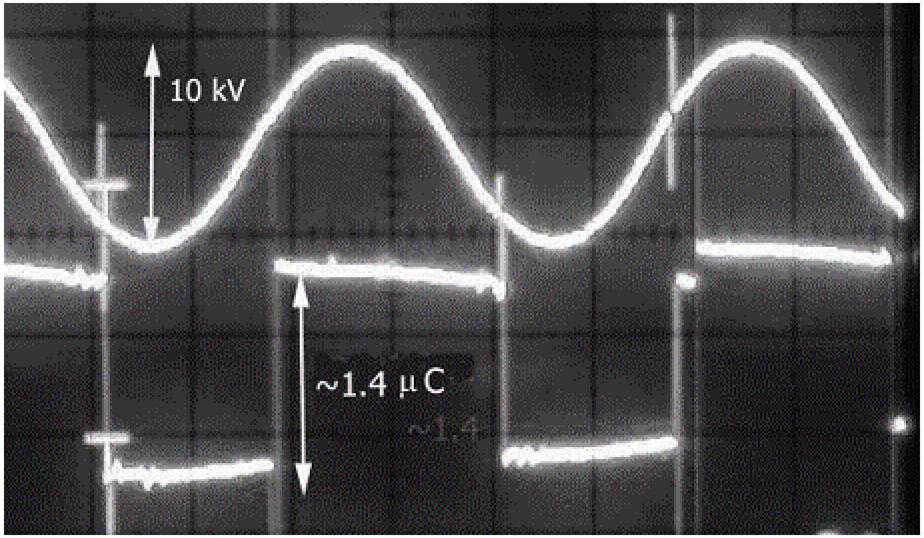
Hexiagonal pattern formation in DBD



Motion and self-organization of filaments in DBD



Total amount of transferred char



$20Q$, ($Q = CV_{BD}$ for single CCE) in the CCMD with 20 CCE under the same condition as in Fig. 6.