Monitoring of the particle breakage based on microwave scattering during compression

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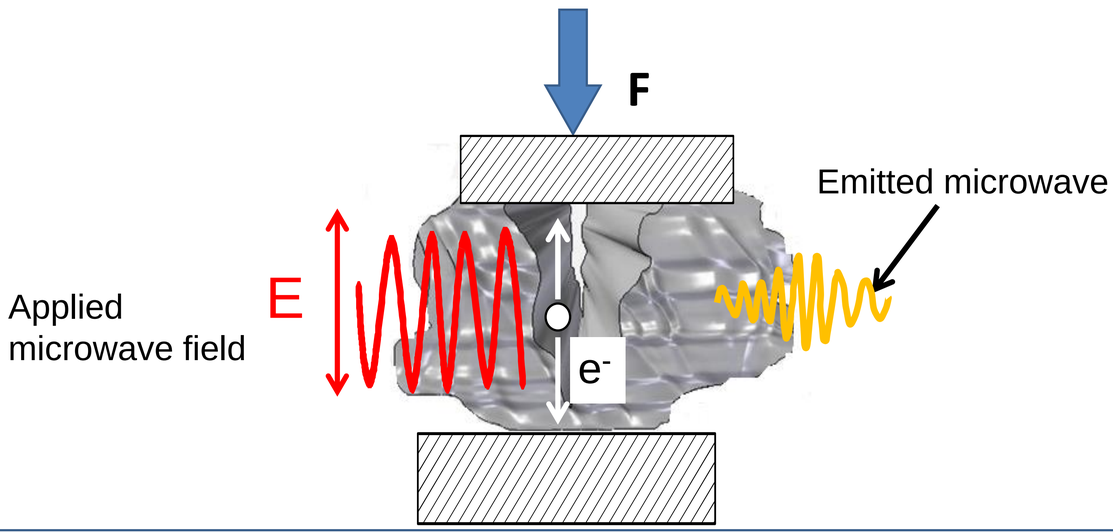
$P_{scatt} = \sigma \cdot p$ P_{scatt} - power of scattered microwave, σ - cross-section, p - energy flux of incident microwave

Tomson scattering of emitted electrons in the crack opening



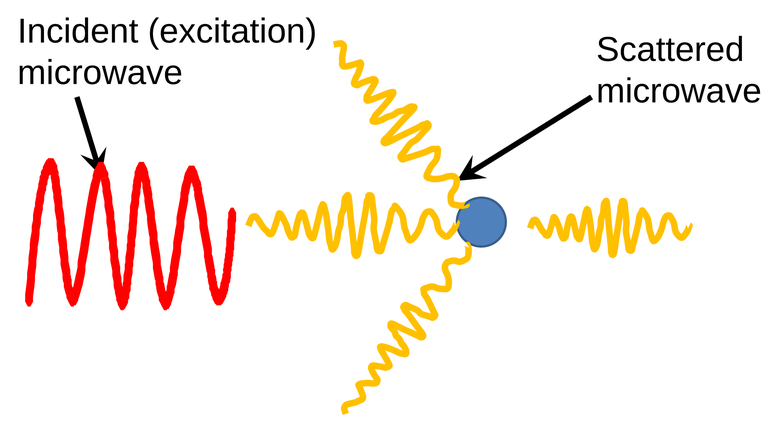
** $P_{scatt} = p \cdot \sigma_t \cdot p \cdot N_e \approx 10^{-10} W$

N_e-number of emitted electrons

σ_t – Tomson cross-section

** Thomson, J. J. (1905). "On the emission of negative corpuscles by the alkali metals". *Philosophical Magazine, Ser. 6* **10** (59): 584–590

Scattering of microwave by small particles



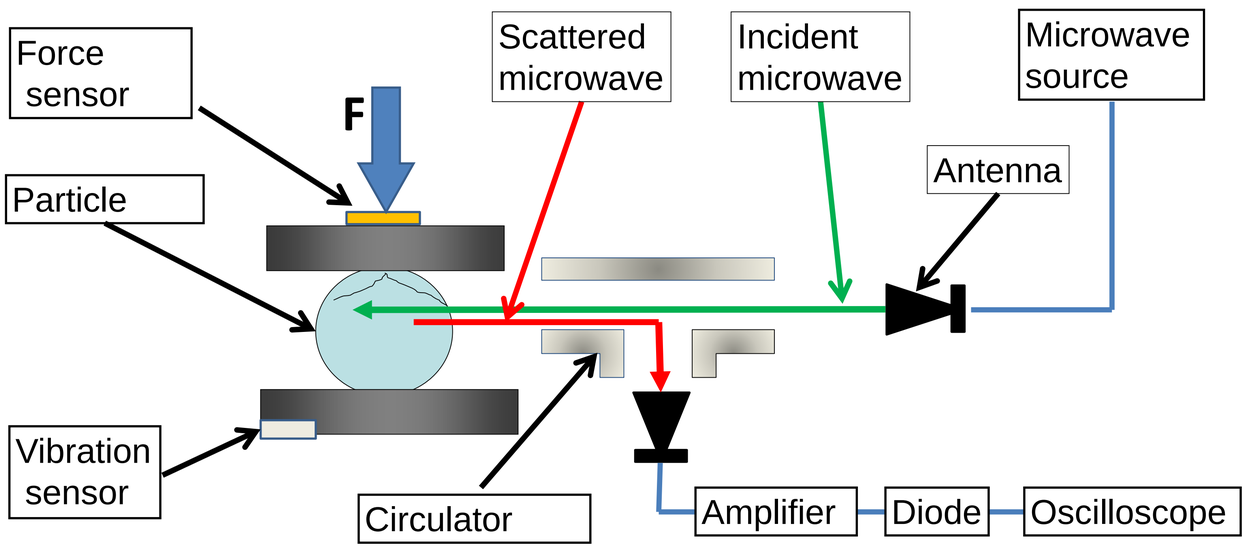
* $\sigma_p = 8\pi\alpha^2\omega^4V^2/3c^4$ $\alpha = \dfrac{3(\varepsilon_r - 1)}{4\pi(\varepsilon_r + 2)}$

ε_r- particle permeability
ω- microwave frequency
V – particle volume
c – light velocity

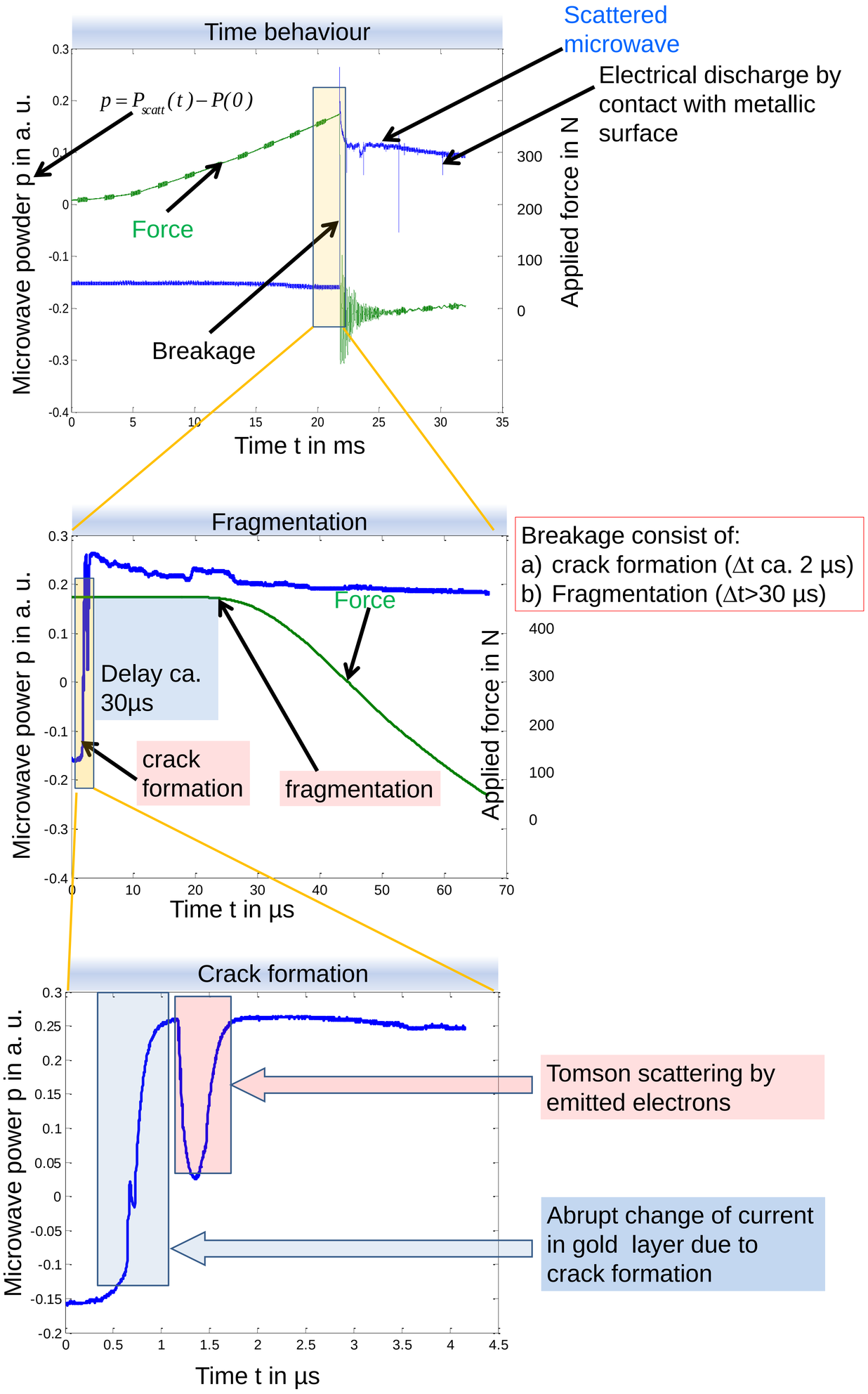
$P_{scatt} = p\sigma_p \approx 10^{-8} W$

*Landau and Lifshitz, Electrodynamics of continuous Media, 2nd etition ,1982, Oxford, New Yourk

Experimental set up

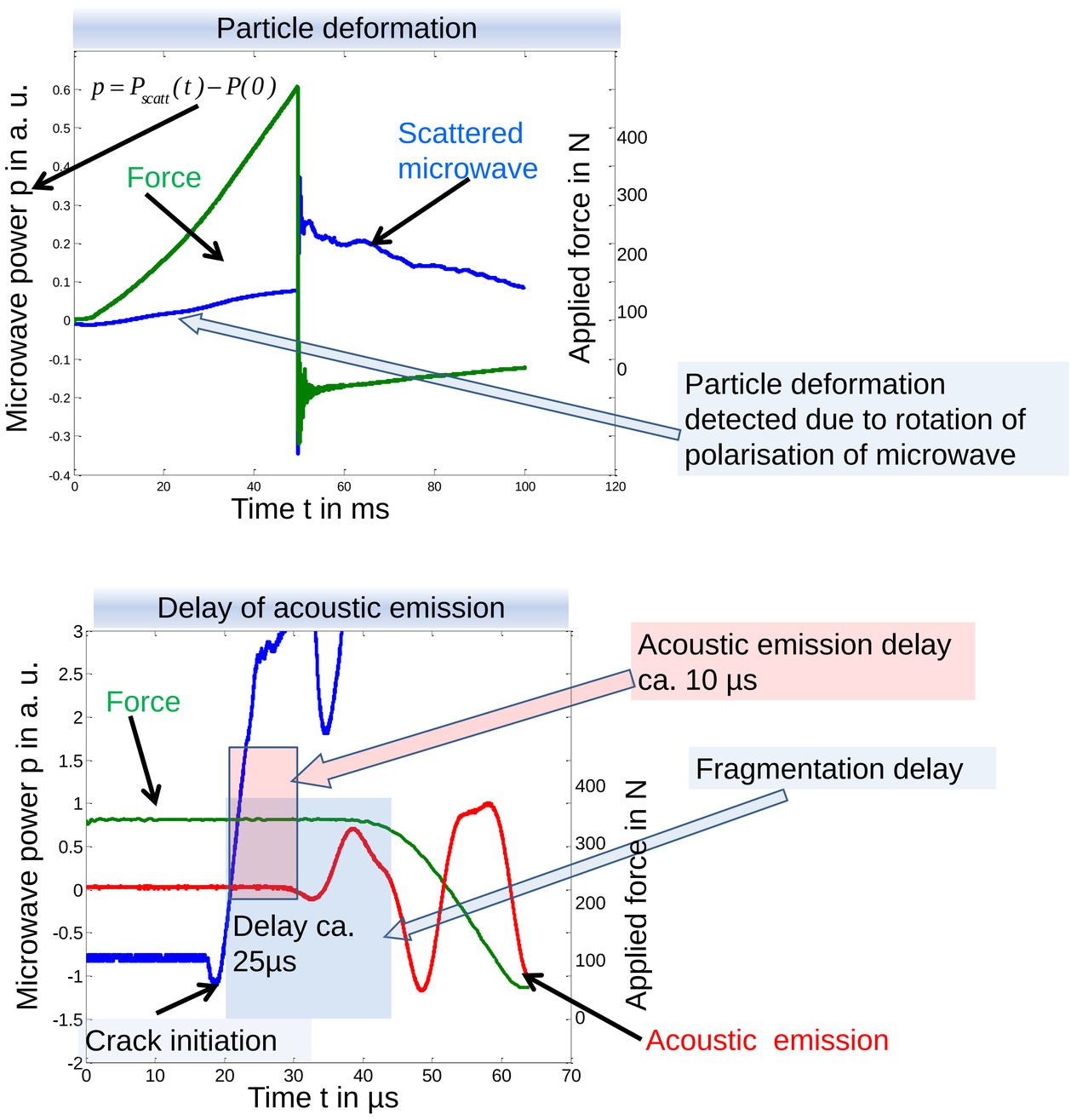


Class particle coved with 50 nm gold layer



Breakage consist of:
a) crack formation (Δt ca. 2 µs)
b) Fragmentation (Δt>30 µs)

Glass particle without gold layer



Microwave scattering can be applied for monitoring of: particle deformation, crack initiation, emission of electrons during the crack formation, measurement of contact time by particle impact.