Cooled Ablation

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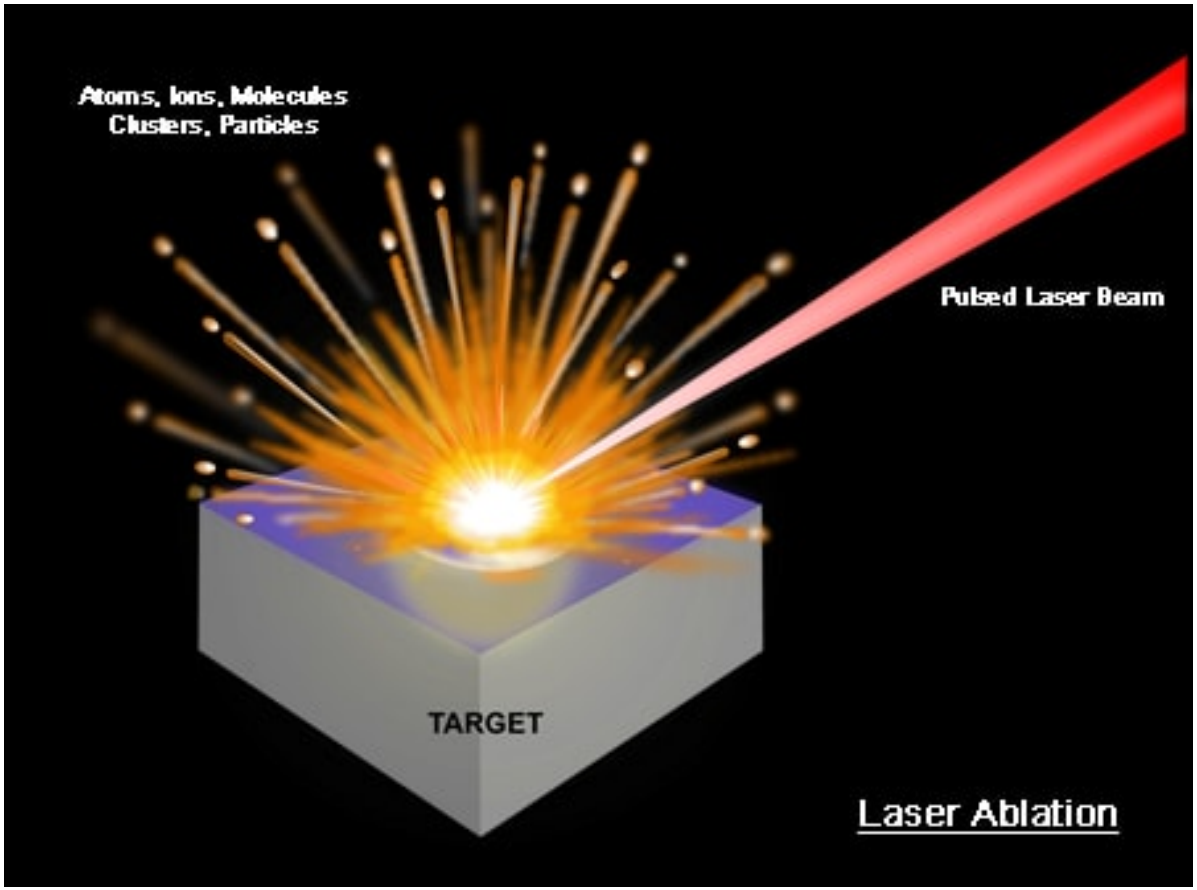
March 19, 2018

1 Introduction
- What is laser ablation ?
- Principles of cooled laser ablation

2 MatLab simulation
- Choices of programmation
- Results

3 Application of this ablation : Dentin Ablation

4 Conclusion



Laser ablation

The "Toy model"

One pulse instantaneous temperature rise: $\Delta T \propto E_p$

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Temperature of the surface encountered by the (n+1)th pulse:

$$T_n + 1 = T_n + \delta T \text{ with } \delta T = \frac{\Delta T}{\sqrt{1+\tau_R/\tau_0}}$$

Ablation after m pulses : Proof

$$T_c < T_{material} = T_0 + \Delta T + \frac{\Delta T}{\sqrt{1 + \frac{\tau_R}{\tau_0}}} + \frac{\Delta T}{\sqrt{1 + \frac{\tau_R}{\tau_0}}} + \dots$$

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$$\Leftrightarrow \boxed{m = \frac{T_c - T_0 - \Delta T + \delta T}{\delta T}}$$

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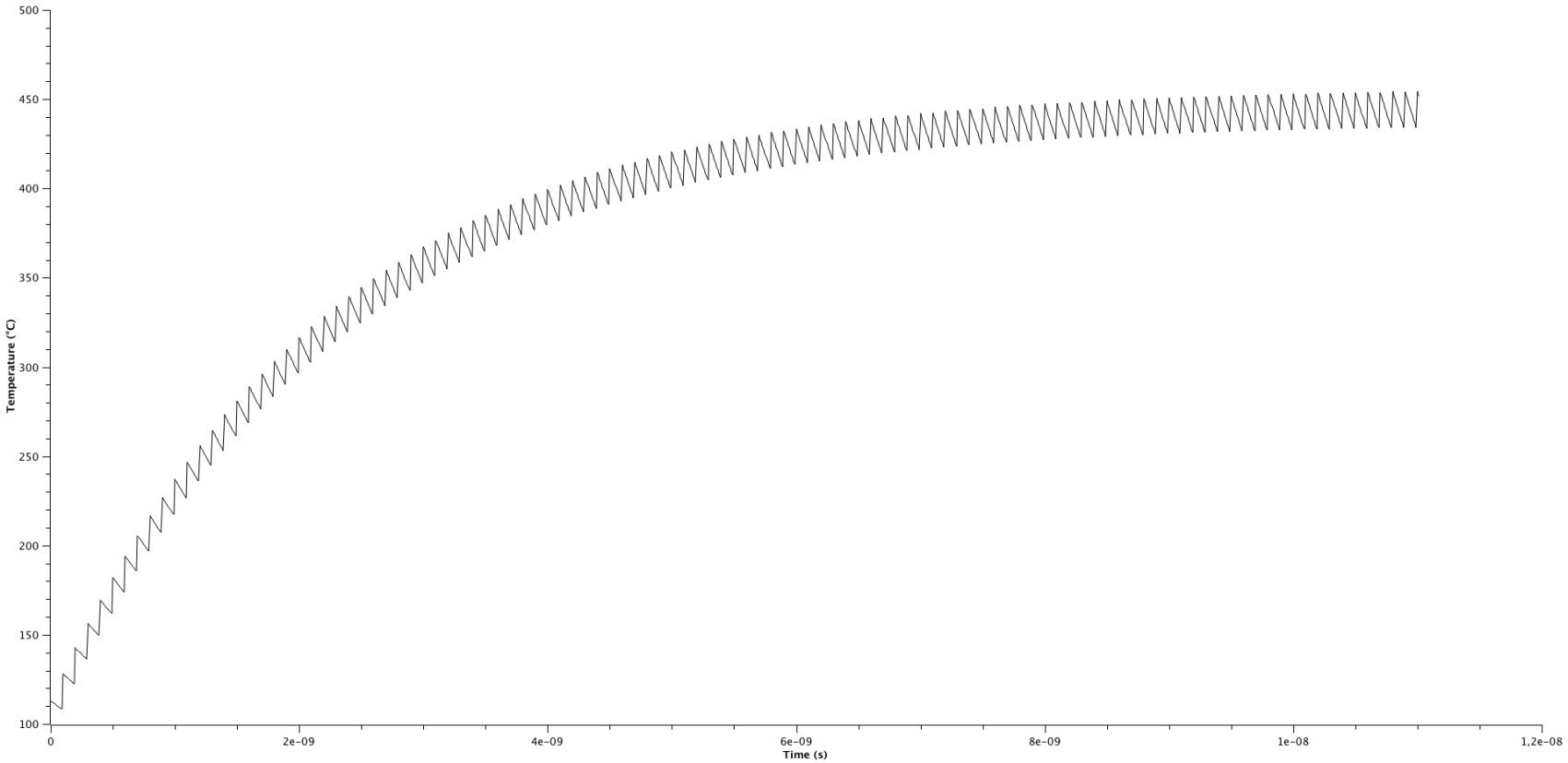
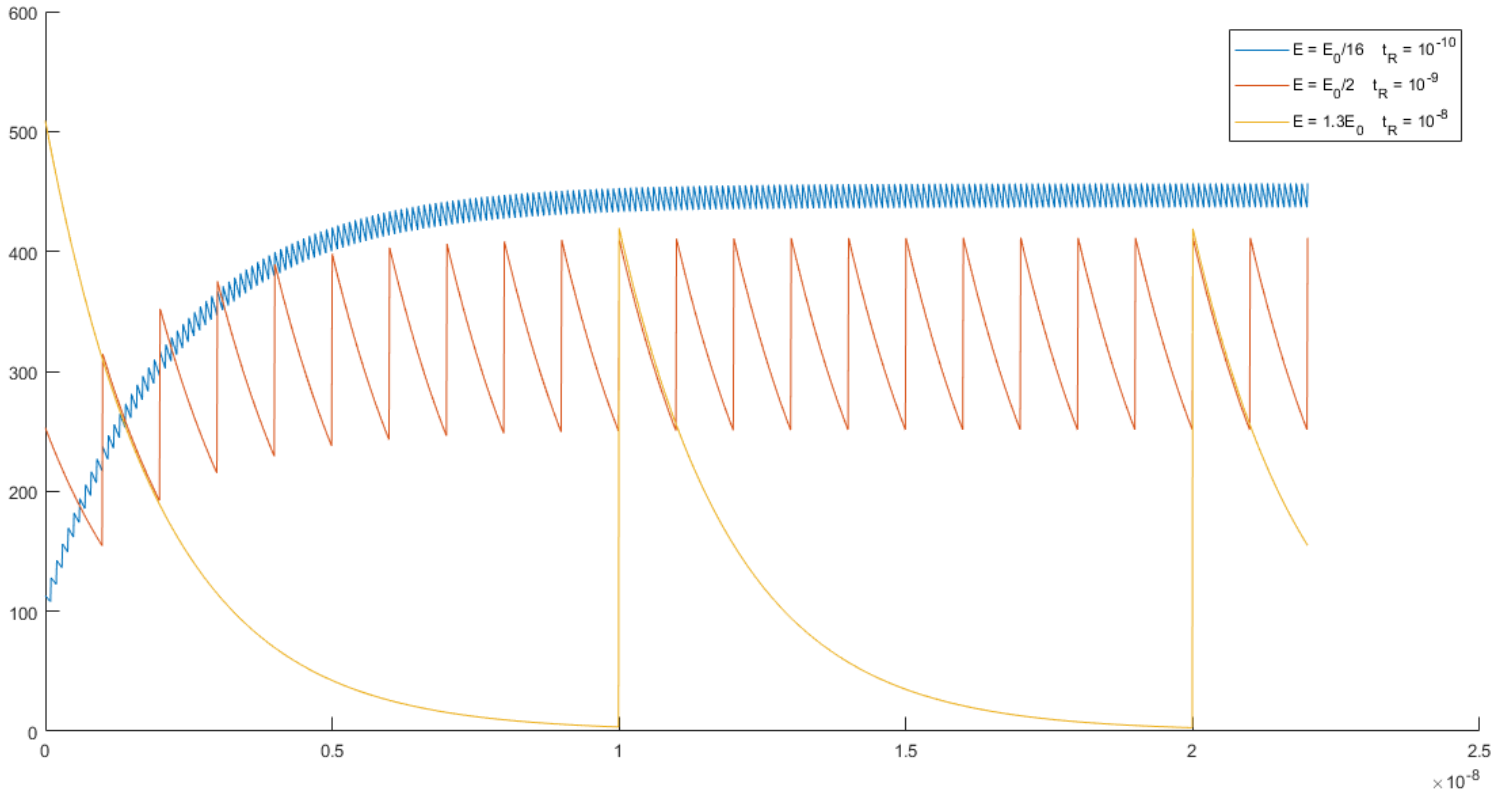
- It is not a free software.

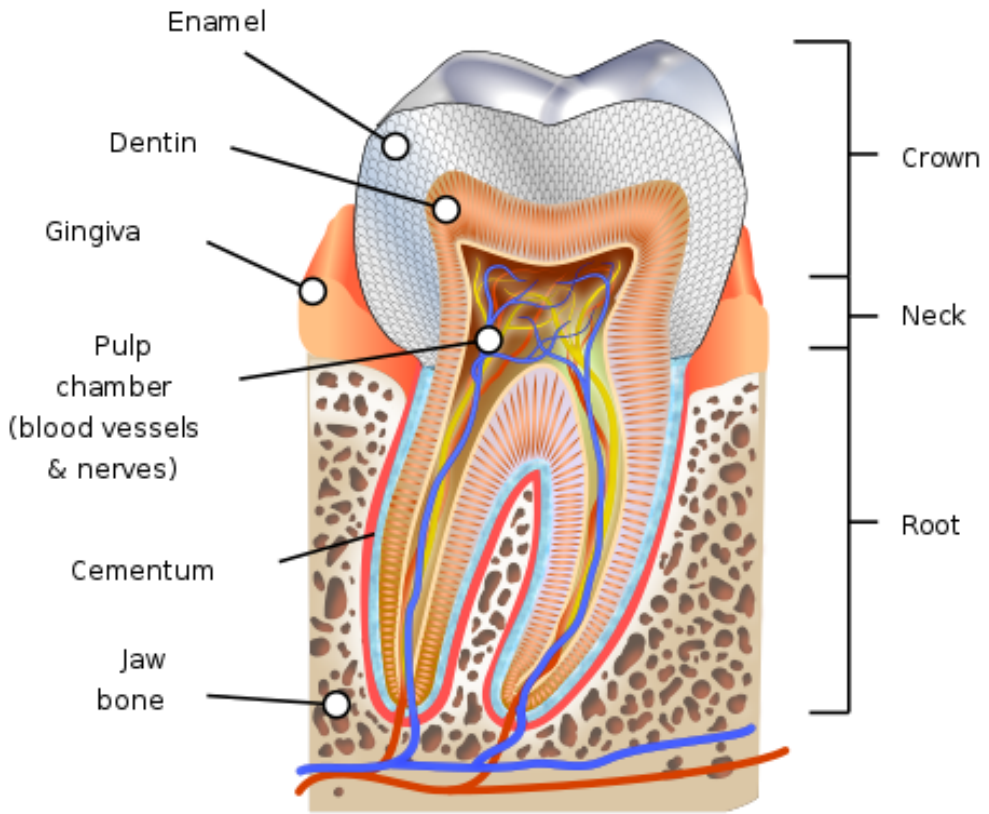


Temperature evolution of the impact point



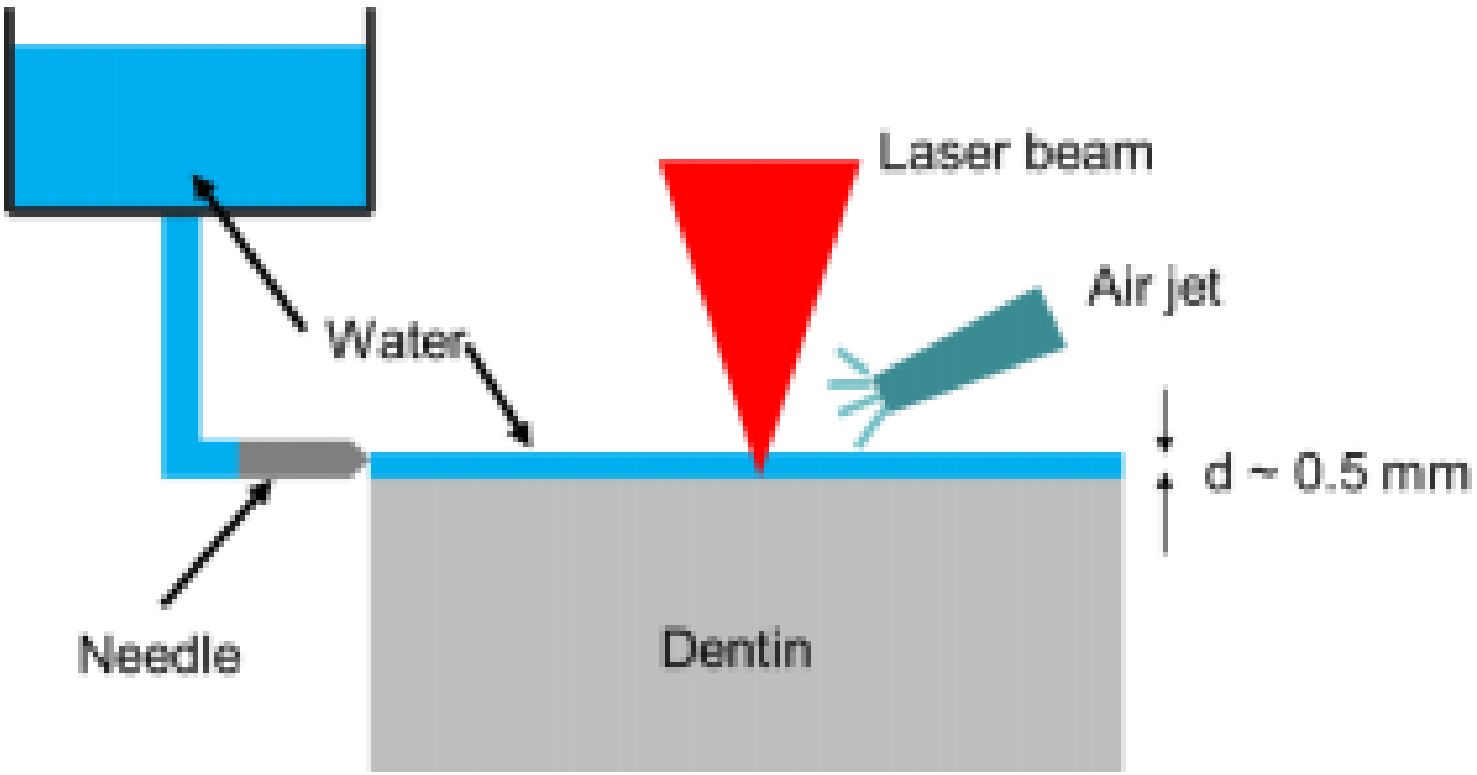
Differents values of E_p and τ_R

What is "Dentin"



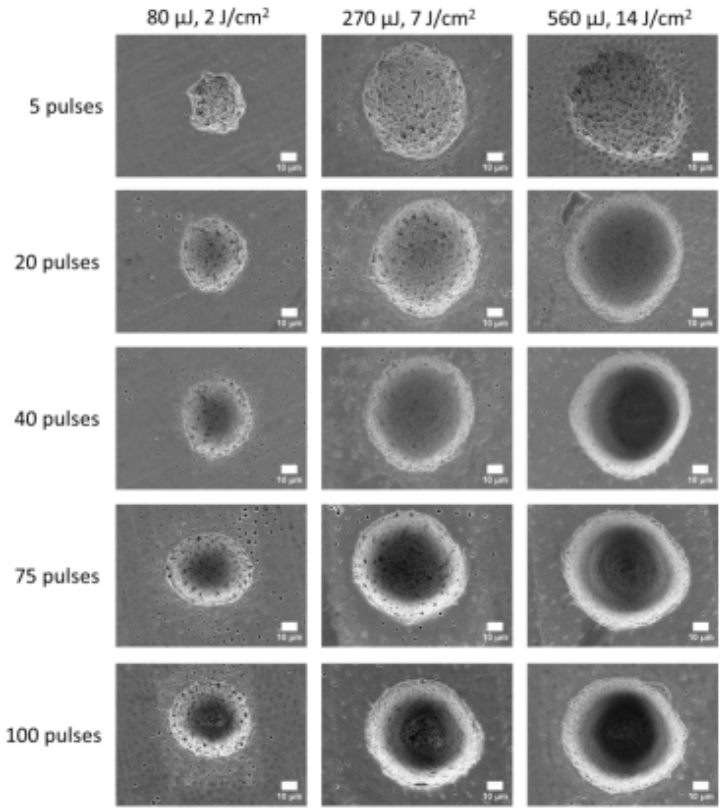
Scheme of the structure of a teeth

Dentin Ablation



The cooling system of the dentin ablation

Results



Ablation of the dentin

Conclusion

- Young process which open new applications of laser ablation,
- Impacts with reduced collateral damages,
- Low energy of laser,
- The theory is young and "too" simple.

Thank you for your attention

References

- "Ablation-cooled material removal with ultrafast bursts of pulses" - Can Kerse, et. al.
- "Laser ablation of dentin and its medical application" - Quang Tri Le