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### 1. Background

Practical low energy consumption HTS magnets

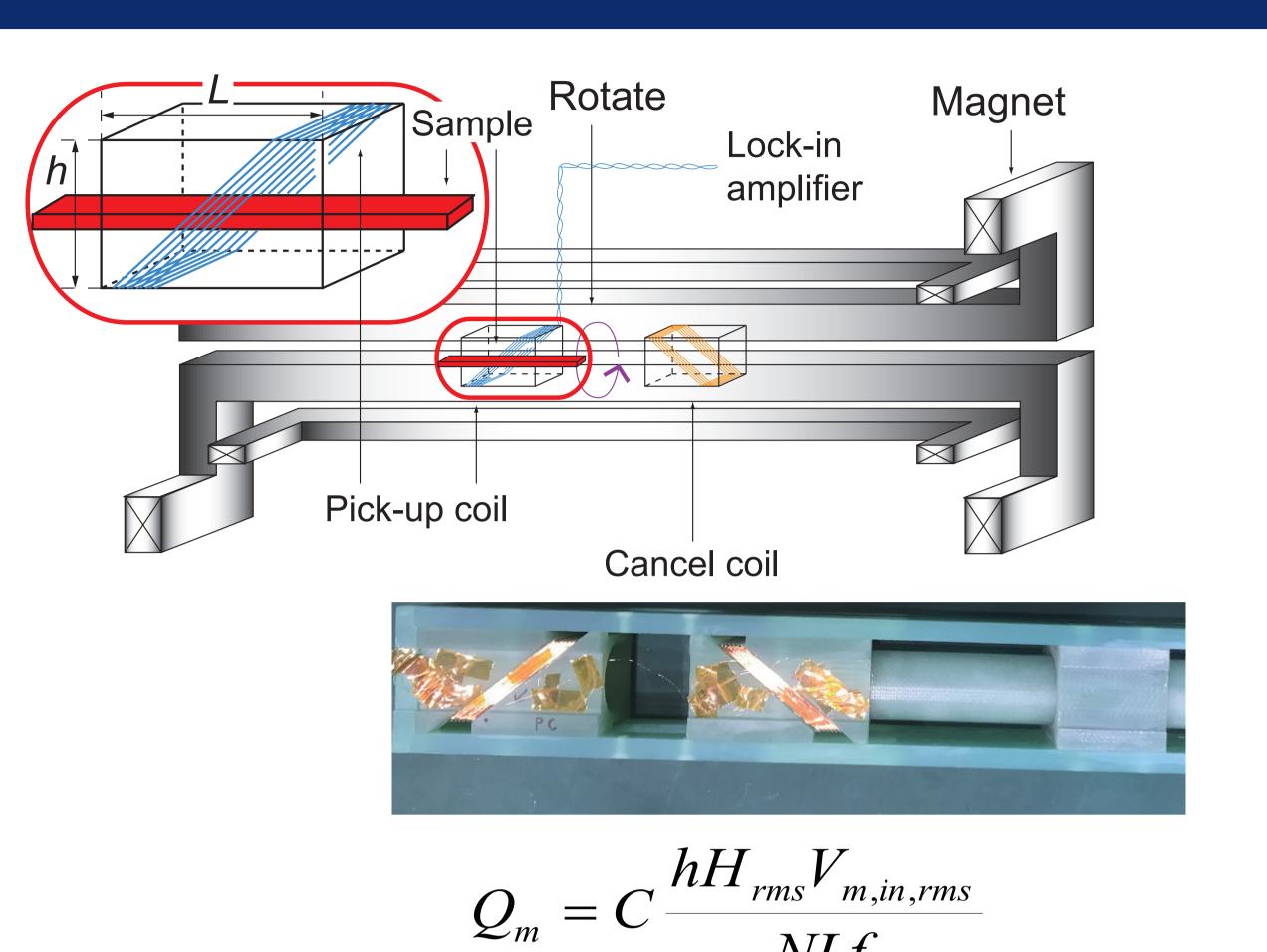
- ★ Key: Reduction of AC loss ★ Measure: Striation
- Stirated coated conductor without conductive metal layer Pros: Obvious Ac loss reduction by striation Cons: Problem with robustness
- Stirated coated conductor with conductive metal layer Pros: Current sharing, heat escape when quenched Cons: Coupling of filaments affect of striation effect Coupling time constant  $\tau$ :

Time for coupling current to decrease by 1/e

#### 2. Measurement system and measurement method

# Measurement system





#### Calculation of coupling time constant

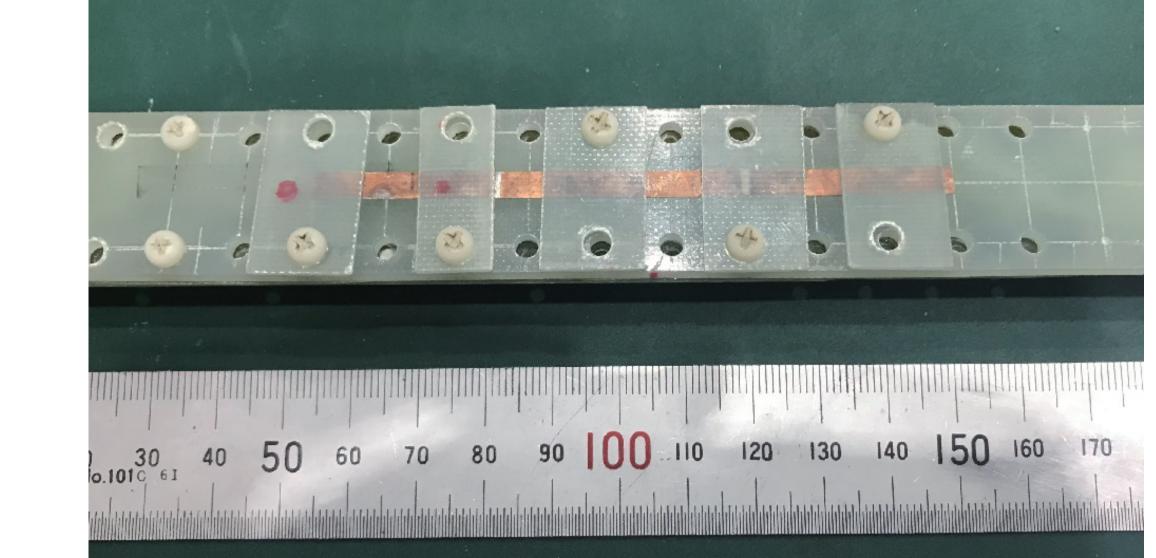
$$Q_{c} = A * \pi \cdot \mu_{0} H_{\rm m}^{2} \frac{2\pi f \tau_{\rm c}}{(2\pi f \tau_{\rm c})^{2} + 1}$$

### 3. Characteristics and setup of the sample

| Specifications of the measured coated conductors |   |  |  |  |
|--|---|--|--|--|
| Width of coated conductor                        | 5 mm                                      |  |  |  |
| Thickness of coated conductor                    | 0.25 mm                                   |  |  |  |
| Material of high-temperature conductor           | GdBCO                                     |  |  |  |
| Thickness and material of substrate              | Hastelloy, 100 μm                         |  |  |  |
| Number of filaments $(n_f)$                      | 4 or 6                                    |  |  |  |
| Critical current* before copper plating          | 141.3 A $(n_f = 4)$<br>91.5 A $(n_f = 6)$ |  |  |  |
| Thickness of copper plate ( $t_{Cu}$ )           | 10 μm or 40 μm<br>at each side            |  |  |  |

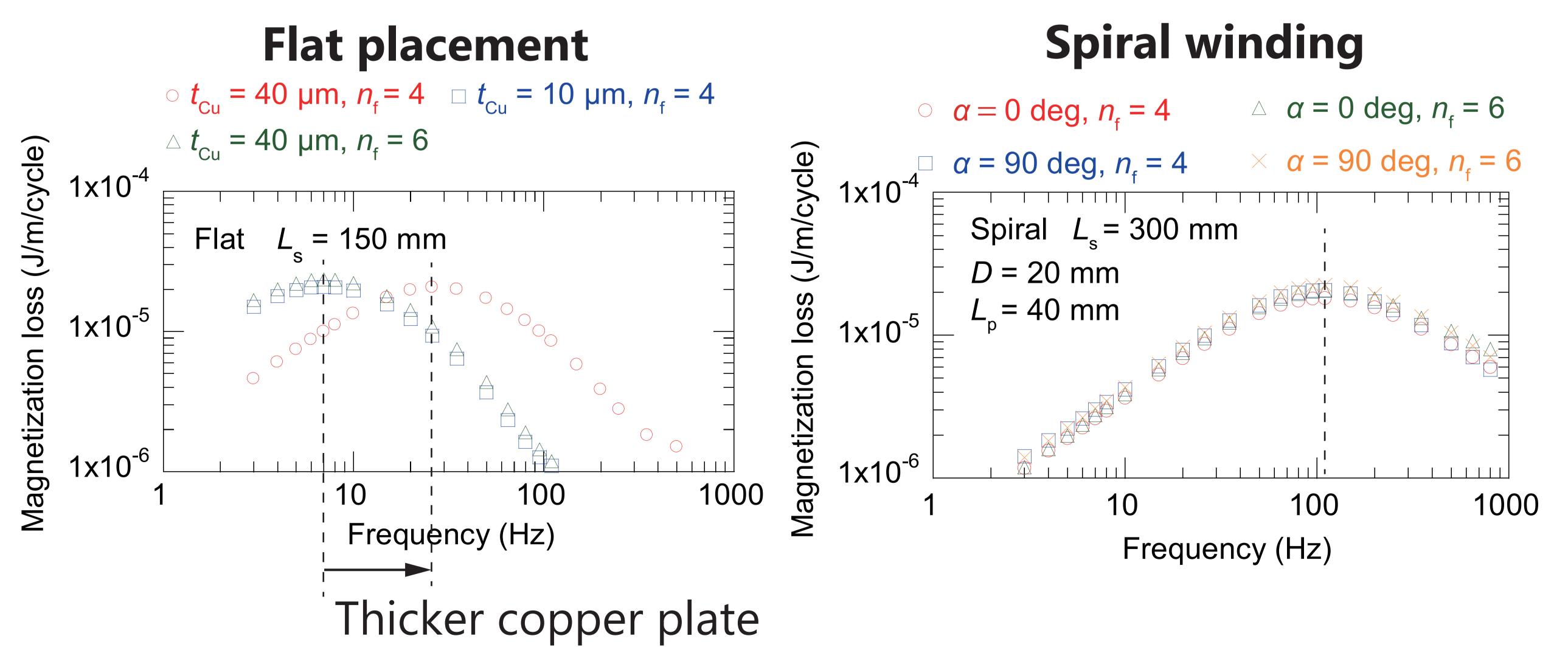
\*Critical current is the current value of conductor when  $E = 1 \times 10^{-4} \text{ V/m}$ .

| Specification of the spirally wound samples |                      |              |        |                  |              |
|---|----------------------|--------------|--------|------------------|--------------|
| $n_{f}$                                     | $t_{\text{Cu}}$ (µm) | $L_{p}$ (mm) | D (mm) | $L_{\rm s}$ (mm) | $L_{c}$ (mm) |
| 4   | 40                   | 40           | 20     | 300              | 37.2         |
| 4   | 10                   | 40           | 20     | 300              | 37.2         |
| 6   | 40                   | 40           | 20     | 300              | 37.2         |
| 6   | 40                   | 15           | 10     | 150              | 17.4         |
| 6   | 40                   | 75           | 20     | 300              | 48.9         |



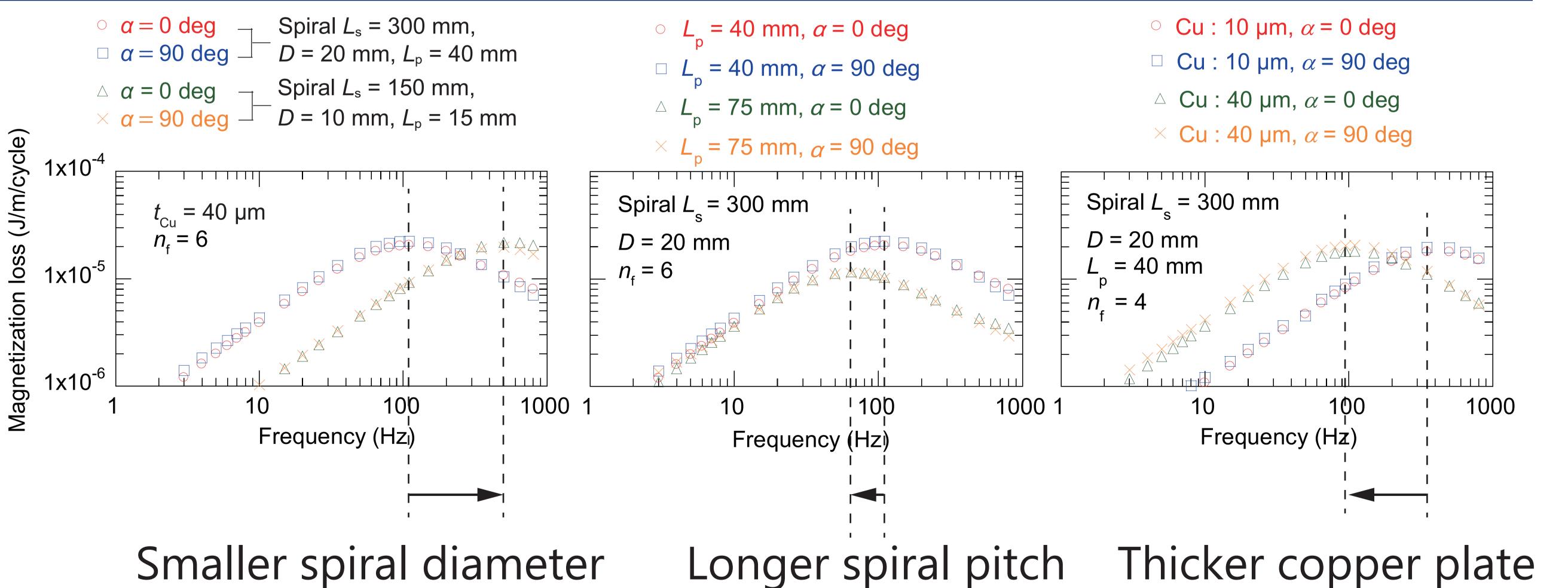


#### 4. Influence of filament number and copper thickness



Influence of number of filaments negligible

## 5. Influence of spiral geomtery



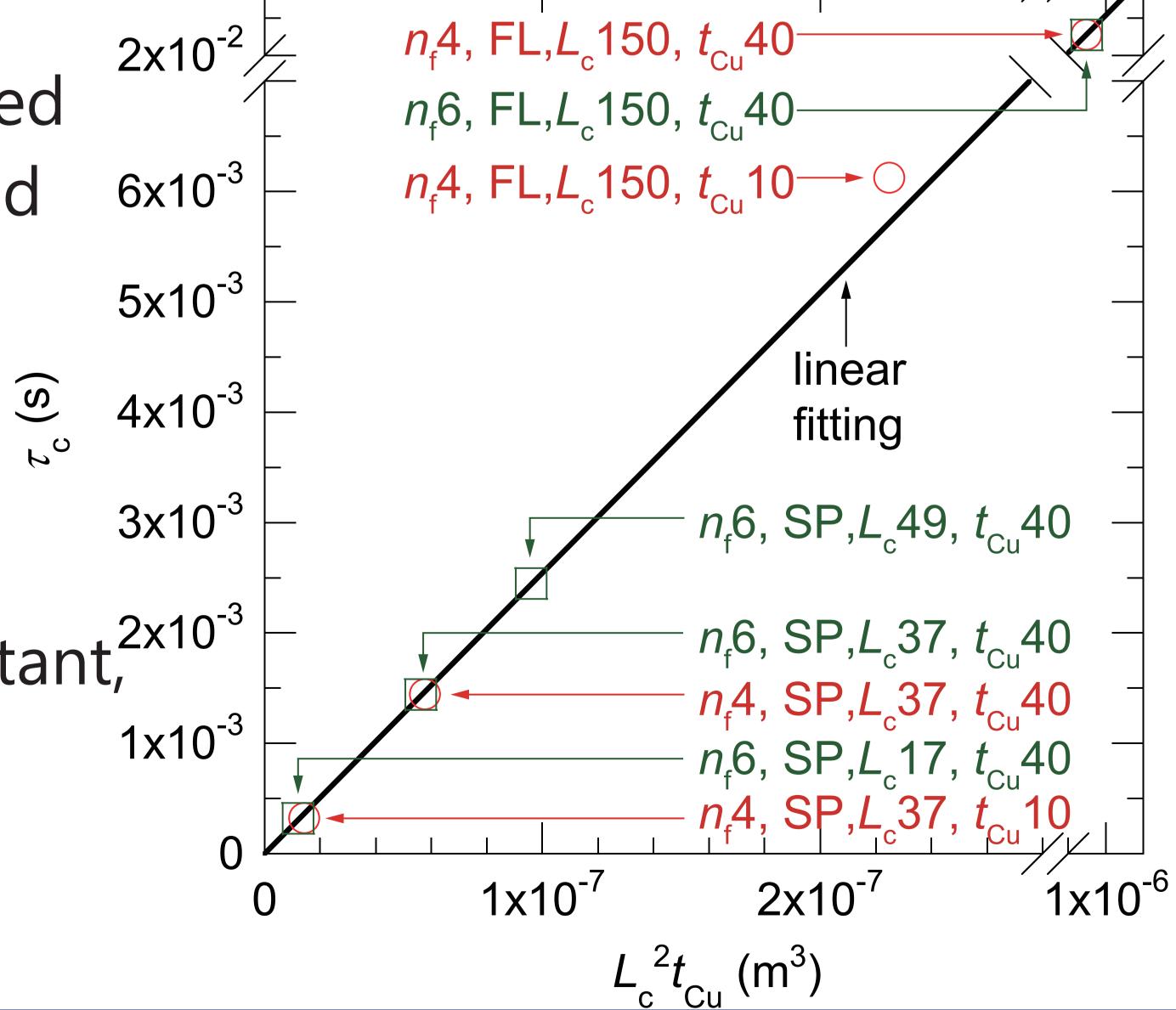
Angle of the magnetic field have little effect on magnetization loss

## 6. Summary

#### Conclusion

Coupling time constant is decided by the length of current loop and resistiance between filaments:

Filament number have little influence on coupling time constant, 2x10<sup>-3</sup> but more filaments should help decrease the ac loss.



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