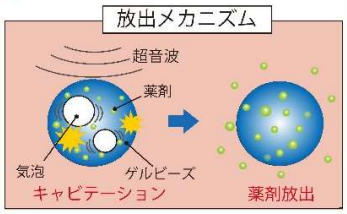
超音波徐放 Drug delivery system

目的

先行研究：超音波による薬物放出制御

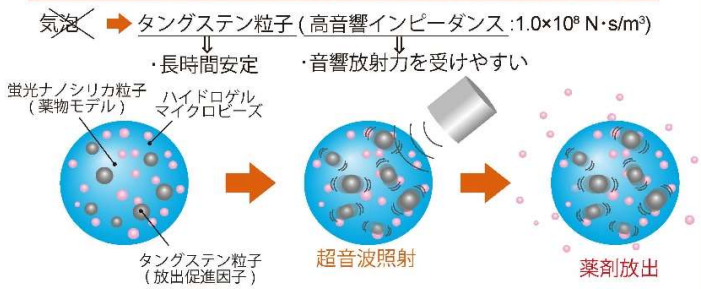


○ 放出位置の制御　　○ 放出時間の制御

- キャビテーションの発生は微小気泡の存在に依存
- 気泡の長時間保持が困難

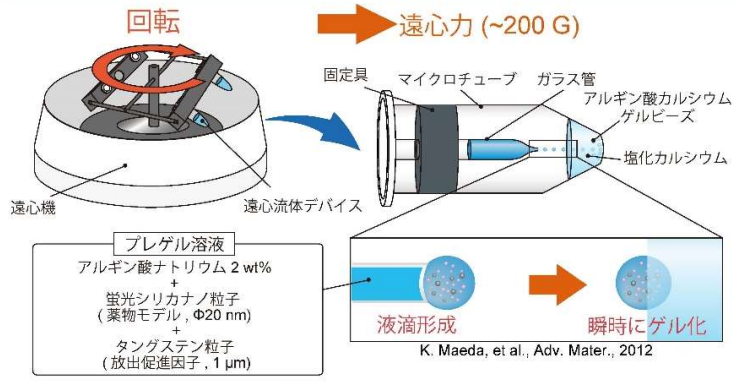
➡ △ 制御に時間制限あり　　△ 高強度の超音波が必要

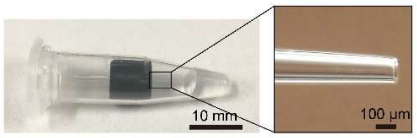
コンセプト：薬物放出促進粒子を用いた超音波による放出制御



○長時間の放出制御　　○低出力の超音波

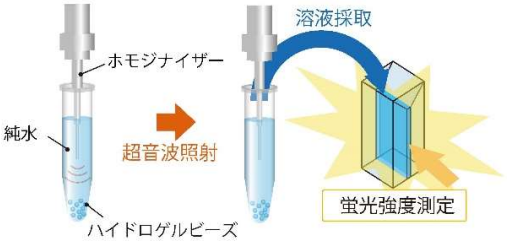
作製手法





○ 容易に作製可能
○ 素早く作製可能
○ 材料を無駄なく利用可能

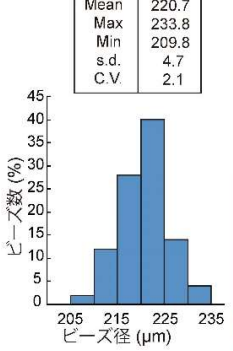
セットアップ

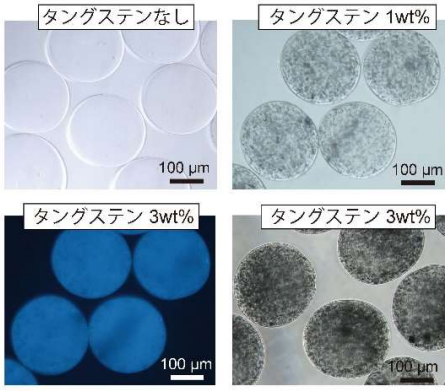


結果

■ ハイドロゲルビーズ

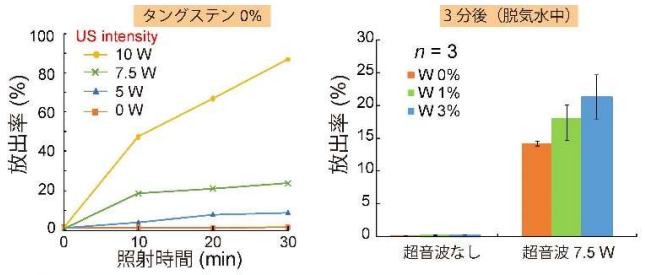
n	50
Mean	220.7
Max	233.8
Min	209.8
s.d.	4.7
C.V.	2.1





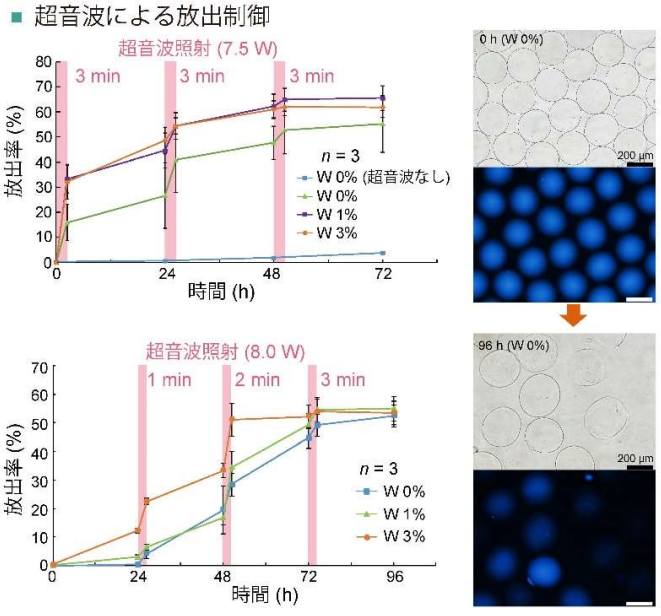
均一なビーズを作製

■ 超音波照射条件とタングステンによる放出率の変化



タングステンがナノ粒子の放出効率を向上

■ 超音波による放出制御



タングステンにより効率的に超音波で徐放制御

結論

- タングステン粒子により薬物モデルの放出効率が向上
- 7.5 W から 8.0 W の超音波で 3 日間の薬物モデルの徐放を制御

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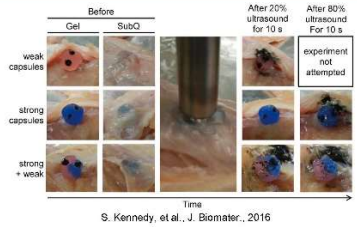
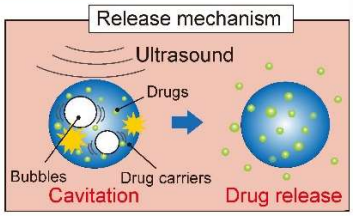
ULTRASOUND-TRIGGERED CONTROLLED RELEASE OF NANOPARTICLES FROM HYDROGEL MICROBEADS BY RELEASE-PROMOTING PARTICLES

Objective

Previous study : Ultrasound-triggered drug release





✓Temporal release control ✓ Spatial release control

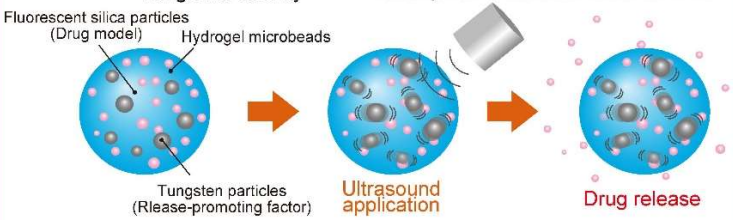
Needs nano or micro bubbles to generate cavitation, but they are unstable

➡ ✕ Short-term release control ✕ Needs high-intensity ultrasound

New concept : Drug release control using release promoting particles

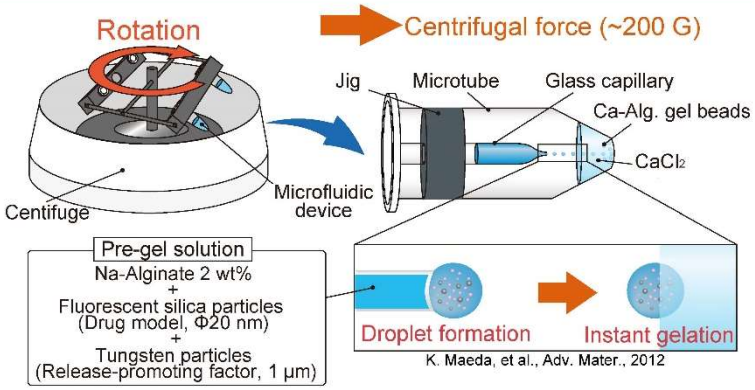
Bubble ➡ Tungsten particles (High acoustic inpedance :1.0×10⁸ N·s/m³)

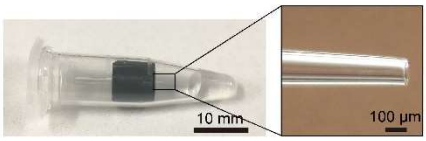
·Long time stability ·Susceptible to acoustic radiation force



✓Long-term release control ✓Low-intensity ultrasound control

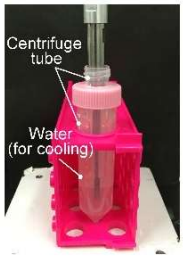
Fabrication method

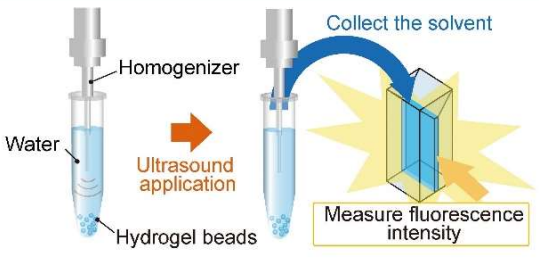




✓Easy fabrication
✓Quick fabrication
✓Efficient use of material

Experimental setup

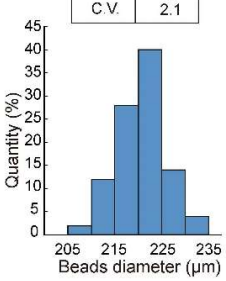


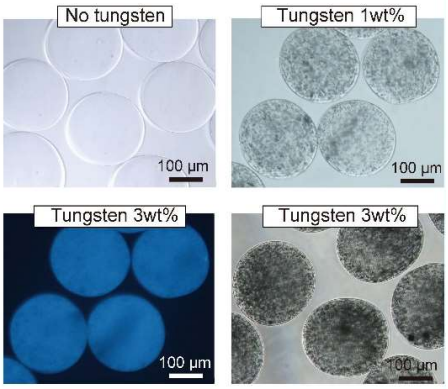


Results

■ Hydrogel microbeads

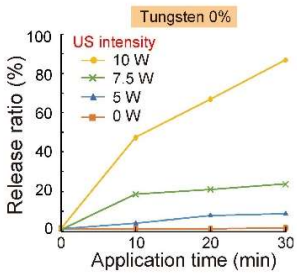
n	50
Mean	220.7
Max	233.8
Min	209.8
s.d.	4.7
C.V.	2.1

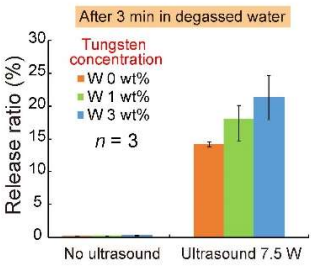




Fabricated beads uniformly

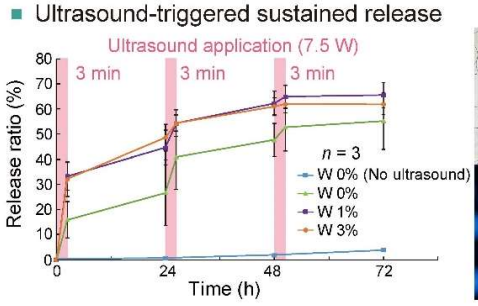
■ Change in release ratio due to ultrasound and tungsten

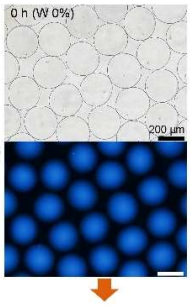


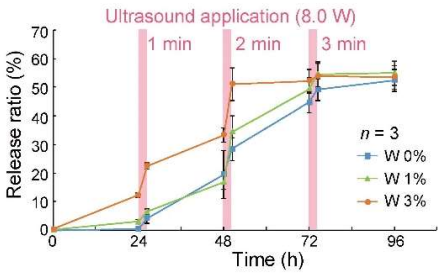


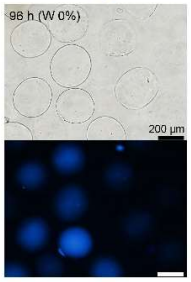
Tungsten increased release efficiency of nanoparticles

■ Ultrasound-triggered sustained release









Controlled and sustined release at low-intensity ultrasound

Conclusions

- Tungsten particles improved release efficiency of drug models.
- Controlled and sustained release for 3 days with ultrasound from 7.5 to 8.0 W.

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