Aspiration Assisted Needle Biopsy Device

Battery Selection

**General:**

Looking for a secondary battery (i.e. something rechargeable that can supply high power discharges) that can maintain 12 V supply over 500mA-1.5A pulse currents.

**Motor Characteristics**:

* 12 V operating voltage
* 10 A stall current
* ~500mA - 2A operational current

**Requirements:**

* Rechargeable
* Long lasting (ideally more than 5 hours of continuous use)
* Charging Time: 1-3 hours at most

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| *Battery Type* | *Notable Elements* | *Potential for Use* |
| Lead-Acid Batteries (flooded, VRLA, SLA) | Flooded types need to be upright so can’t be used for mobile applications. Similar for VRLA. SLA can be moved. Low self-discharging rate and no memory effect. Take 8-16 hours for full recharge. Recharging can be very technical. Custom battery chargers could explode. | Low |
| Nickel-Cadmium (NiCAD) | Discharge volage of 1.2 V per cell with this being consistent until near full discharge. Discharging is quite high with the battery lasting 2-3 months. Mobile, higher energy density, low cost. Suffers from memory effect. ~10 hour constant charge at maximum. May require full discharge. Float charger. | Low |
| Nickel Metal Hydride (NiMH) | Less memory effect but require full discharge or else crystallization will occur. Nominal voltage of 1.2 V per cell. Higher energy density but shorter work life than NiCAD. RC vehicles and power tools applications. Complex recharging process. | Medium |
| Lithium-Ion (Li-ION) | Extremely high energy density. No memory effect and can shelf last ~ 6 months. Good but not great at deep discharging. High internal resistance. No trickle or float charging. Expensive. Around 3 hour charging time. | High |
| Lithium Polymer (Li-Po) | Typically less expensive than Lithium-Ion batteries sharing similar energy density and charging characteristics. Very high internal resistance. | High |

**Comparison of Li-ION and Li-Po Battery**

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| *Lithium-Ion* | *Lithium Polymer* |
| * Lower energy density * More stable with longer lifespan * Many form factors * More robust physically * Safer and more reliable * Lower discharge rates * Bigger and heavier * Generally safer with simpler charging devices. * More pronounced voltage drop near the end of discharge. | * Designed for higher discharge rates * Lighter * Many form factors * Higher energy density * More sensitive to charging conditions * Shorter lifespan with deep discharging * Will require a balance charger. * Faster charging |

**Recharging and Other Considerations:**

The voltage of the battery will likely be within the range of 13-11 Volts. It is important to double check the operating voltage of the motor. It likely will be fine but it would be good to get confirmation on this.

Generally speaking, LiPo and Li-Ion batteries have more involved charging processes with specific chargers, configurations, and demand for a greater level of attention. It would be ideal if this could be abstracted to something similar to the iPhone, where a lot of the balancing technology for the battery has been simplified for easy use.

One potential option is the TP4056 which is an IC that could enable us to charge the Li-Ion or Li-Po with a 5 V USB power source. This type of solution would demand

1. USB Power Delivery or a charging block
2. Charging components like the TP4056 or some battery management system (roughly 3x2 cm).
3. Something to regulate the input voltage from USB
4. A protection circuit to avoid damaging the battery (although built in ones inside the battery might suffice)