Product Design Specifications

Title

Creation of a live cell-imaging device for use with laser-based confocal microscopy.

Team Members/ Roles

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Abstract:

Live cell imaging is crucial in understanding the behavior of many types of cells, including stem cells. Through the observation and research of the behavior of these cells under controlled environments, much useful information can be gained. This information could possibly lead to great advancements in healthcare, including the treatment of diseases once though untreatable. Currently, live cells can only be kept under the microscope for no more than 3 hours. Research could be far more useful if this length were to be increase to at least 48 hours. It would result in far more useful investigations, and could aid in the quality and effectiveness of current live cell research.

Problem Statement:

Design a live cell imaging chamber that gives the observer control over variables such as temperature, gas content, and cell media concentrations.

1. Client Requirements:

a. Performance Requirements: The client has suggested two improvements be made to the current cell imaging system. Firstly, the client would like to be able to control the level of atmospheric carbon dioxide. Secondly, a perfusion system, which allows the client to administer different drugs in a controlled manner to the culture, is desired. The client leaves the choice of which system to build to the team, although a system which combines both would be exceptional.

b. Accuracy and Reliability: The atmospheric carbon dioxide should be kept at 5%. The system should have a gas sensor built in as to provide feedback to a system that monitors and controls the carbon dioxide levels. A perfusion system should be able to deliver an aqueous drug to the culture at a rate near 1 mL/min.

c. Life in Service: Unknown at this point.

d. Materials: The device will be designed as to suit current 35 mm circular glass bottom petri-dishes. The dishes are made of plastic with a glass slip inserted in the bottom for better focus during microscopy. The solution should contain parts that are easily sterilized between uses, or contain cheap parts that may be replaced with each use.

e. Aesthetics, Appearance, and Finish: The device will be used in a

laboratory situation, so aesthetics are not crucial to the success of the final product.

f. Shelf Life: Ideally, the product would not wear down until initially used.

g. Operating Environment: The device will be placed on the platform above the objective of the microscope. The platform measure 25cm by 20 cm, and has a limiting height of 10cm.

h. Size and Weight: The device should be no larger than the platform on which the imaging takes place.

i. Ergonomics: Should be easy to use and operate.

2. Production Characteristics

j. Quantity: Preferably, one reusable device should be constructed.

k. Target Product Cost: Under $1,000

3. Miscellaneous

l. Standards and Specifications: Must be able to fit in space above confocal microscope, and bottom of petri dish or other housing design for the samples must be exactly on the stage so that imaging microscope can image clearly from below the chamber.

m. Patient Related Concerns: Diffusion and concentration of gas with the media in the petri-dish can affect proficiency of the media in sustaining sample. Also there must be easy distribution of both these supplies throughout the chamber.

n. Competition: There are existing models of this device that fulfill requirements. Devices are currently very complicated and very expensive. For the purpose of this project, the device would not need to be integrated as these existing products are.