

UNITED STATES PATENT OFFICE

2,517,523

BIOLOGICAL WINDOW

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No Drawing. Application April 15, 1949,
Serial No. 87,840

5 Claims. (Cl. 3—13)

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The invention relates to biological windows, and more particularly to biological windows constructed entirely from transparent material other than biological-like material.

Heretofore, in the construction of biological windows for living organisms, it has been known that such windows can be made either by the use of transparent living tissue or by cutting an opening in the surface of the object to be observed. However, due to the fact that most tissue is non-transparent, the only satisfactory method has been by cutting an opening and leaving the opening without covering, thereby incurring the possibility of infection from outside sources. As one application of successful biological windows, it has been found that the cornea of the eye may be successfully replaced by substitution of a normal cornea from outside sources such as corneas transplanted from other living or recently deceased sources. While these implantations are fairly common today, there is the necessity of obtaining donors who are willing to either donate the cornea from an eye while living or upon their demise; and while it has been found possible to store these corneas for future implantation in "banks," this process requires storing for a very limited period of time under exact refrigerated conditions to preserve the corneal tissue until the implantation may be effected.

It has been appreciated for a long time by those skilled in the biological sciences that a true window for subcutaneous tissue which would be tolerated by the living tissue surrounding the window would be extremely valuable in reserach efforts. However, the usual transparent non-biological materials such as glass, resins, Celluloid, pastics or quartz cannot be tolerated in direct contact by living tissue, and either tend to be sloughed off or to set up a local irritation so that the transparent material cannot be firmly bonded to the tissue. By virtue of the present invention, a method is presented for treating the aforementioned transparent materials with an inorganic metal selected from the group consisting of tantalum, columbium and zirconium which are well tolerated in direct contact by biological tissue.

It is an object of the present invention to provide biological windows constructed wholly of non-biological materials which may be incorporated into the tissue surrounding the window.

It is a further object of the present invention to provide corneal transplants composed wholly of non-biological materials.

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Further objects and advantages of the present invention will become apparent from the description as set forth hereinafter.

In carrying out the present invention, glass or other transparent material is cut to the desired size and placed within apparatus such as that shown in Case Patent No. 1,584,728, issued May 18, 1926, wherein there is shown a chamber adapted for high evacuation and partially surrounded by a set of induction furnace coils. The transparent material to be coated is located above a crucible which contains the coating metal of tantalum, columbium or zirconium to be heated by the furnace. By this arrangement the metal is heated to a temperature above its evaporation temperature, which in the case of tantalum is approximately 3000° C., and then permitted to condense upon the cooler transparent material located above the crucible. By controlling the amount of time that the base material is exposed to the vapors of the metal, a homogeneous, enveloping coating may be produced upon the material. So long as the coating is not greater than approximately 1×10^{-4} cm. over at least the central portion of the base material, the light transmitting characteristic of the base may be held to at least 50%. A method of treating transparent materials with a metal coating to maintain the transparency of the base over a desired portion of the surface is disclosed in Patent 2,351,536, issued June 13, 1944, to Osterberg et al. Preferably, but not necessarily, this thin coating should be applied only to the center of the base material; and the outer periphery of the base should be more heavily coated. In this way, the outer edges of the coating material may be more firmly bonded to the base so that subsequent handling of the window will not impair the homogeneity of the metallic coating, since the greatest likelihood of damage to the coating will be near the periphery of the base material. Likewise, by presenting a thicker coating along the peripheral edges of the base material, it is possible to form a matrix-like, or roughened, portion around the window which is more readily adapted for incorporation by the biological tissue in the desired location. In this way a firmer bond may be created between the biological tissue and the metal coating of the base material so that permanent attachment may be obtained without the danger of slippage of the window relative to the living tissue.

As mentioned hereinbefore, the present invention comprehends the use of any of three metals,

namely, tantalum, columbium, and zirconium, or any combination thereof, for coating the transparent base material. Each of these metals and their combinations has been found to be highly compatible when placed in contact with living biological tissue since each is essentially inert to both acids and alkalis normally present in biological fluids. Accordingly, these metals are highly acceptable to the adjacent biological tissues and have been found to be so compatible that when slightly roughened, biological tissue will adhere and grow around the metal.

By the use of biological windows constructed in accordance with the present invention, a method is provided for observing the functioning of internal organs in the furtherance of biological research. For example, an abdominal window may be prepared by cutting a transparent plastic base to the desired size, and then covering the base with an enveloping transparent coating of tantalum by the evaporative technique described above. A matrix or mesh-like portion of the same metal is then applied either by shielding the portion desired to be transparent and continuing the evaporation, or by either sputtering or fusing additional tantalum to selected portions of the base coating. After the window is prepared, the usual operative technique is employed to incorporate the window in the abdominal wall.

In addition, the present invention provides a method of preparing corneal transplants to replace the necessity of obtaining compatible living corneal tissue by the coating of preferably a transparent plastic or resin with tantalum, columbium or zirconium in a manner similar to that described above in preparing an abdominal window.

I claim:

1. A biological window comprising a transparent base and an enveloping coating for said base of at least one metal of the group consisting of tantalum, columbium and zirconium, said coating being transparent over at least a portion of the surface of said base and providing biological tissue attaching means over another portion so that when said window is adjacent biological tissue slippage between said window and said tissue may be prevented.

2. A biological window comprising a transparent base, a transparent coating of at least one metal of the group consisting of tantalum, columbium and zirconium for said base, a biological tissue attaching means provided by a portion of said coating whereby biological tissue may adhere to said attaching means to prevent slippage between said window and said tissue.

3. A biological window comprising a transparent base, a transparent coating of tantalum for said base and biological tissue attaching means provided by said tantalum coating at the peripheral edges of said base whereby said attaching means may provide adherence between said window and the biological tissue in which said window is incorporated.

4. A biological window according to claim 3 in which the peripheral edges of said window are roughened to provide better adherence to biological tissue in which said window is implanted.

5. A biological window according to claim 3 in which the peripheral edges of said window are coated with a non-transparent layer of tantalum.

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No references cited.