

計畫編號：03

計畫名稱：液晶高分子奈米環氧複合樹脂在牙科冠心-根柱系統應用之開發

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計畫中文摘要：

人類牙齒因為種種原因而要進行根管治療，這類牙齒也往往在術後需要製作假牙冠來保護，以避免未來發生牙齒斷裂的情形，而延長根管治療完後的牙齒在口內之服務年限。然而，在製作牙冠時，需要一定量的齒質以提供未來牙冠的固持性，當齒質因之前的破壞太嚴重，就必須先製作冠心-根柱系統，才能進一步製作假牙冠。

傳統上，是以合金鑄造出冠心-根柱系統，這是一樣已經發展得很成熟的技術，然而必須花費兩次的診療時間來完成它，而且當用在牙列的美觀區時，因為金屬的顏色容易透出，故而限制了較美觀自然的全瓷冠在復形上的應用。加上合金與殘餘齒質的彈性係數相差太大，受力變形量差異大之下，黏著劑失效、根柱斷裂及牙根斷裂便時有所聞。

針對鑄造冠心-根柱系統的改進，有許多種新材質製作而成的冠心-根柱系統紛紛問世，目前最受矚目的就是纖維加強樹脂的預製型根柱，搭配冠心用樹脂以運用在臨床，但仍有一些限制諸如：當根管口因根管治療修型而開展太大時，為了讓根柱與根管壁盡量貼合，勢必要選用較粗的纖維加強樹脂根柱，如此在做根柱空間修型時，鑽針穿破牙齒或造成靠近根尖處齒質不足的機率就上升許多，使得臨床操作上風險大增，甚至可能發生牙齒必須拔除的情況，這對醫病雙方來說都是非常難以接受的。再加上纖維加強樹脂根柱內所包埋的纖維非常強韌，當根柱斷裂或需要重新做根治療而有必要移除它時，移除上會非常麻煩，並且容易造成修去太多殘存齒質或穿破牙齒的情況。本研究團隊已研發具有液晶之高強度液晶高分子奈米環氧複合樹脂，液晶分子的硬桿結構本身就可提供有機基質優異的機械強度以及穩定的熱性質，此外液晶分子在適當的條件下，能夠展現出自組裝(self-assembling)的行為，形成微結構而達到自我強化(self-reinforcing)之目的。環氧樹脂聚合過程中的開環反應可補償聚合反應過程中消失的自由體積因而減少聚合收縮度，而提高所製作的結構物以及裝置之精度。另一方面液晶環氧樹脂聚合後所建立的網狀交聯結構可避免傳統液晶型高分子之機械性質具有方向性的缺點。本計劃將利用液晶高分子奈米環氧複合樹脂開發牙科冠心-根柱系統並發展可同時光聚合及化學自聚合的液晶高分子奈米環氧複合樹脂黏著冠心以產業化。

計畫英文摘要：

Teeth receiving root canal therapy need crown restorations for protection. Casting metal had been used as core-post system for these teeth previously. However, this casting metal core-post system is not perfect because of time consuming and deficiency of esthetics. Due to the unsatisfied color of metal itself, this casting metal core-post system

has limited application in esthetic dentistry for full ceramic crown restorations. In addition, due to the high differences of elastic modulus between metal and tooth structure, tooth fracture is happened frequently. In the development of Esthetic Dentistry, it is very important to have an esthetic core-post system with high strength.

Specific Aims

The specific aims of this project are to

1. Develop high strength liquid crystalline epoxy nanocomposite
2. Apply newly developed dual curable liquid crystalline epoxy nanocomposite for dental core system
3. Apply thermal set liquid crystalline epoxy nanocomposite for dental post system
4. Cooperate with manufacturer for marketing

Preparation of liquid crystalline epoxy nanocomposite

The first step of this project is to prepare two types of the liquid crystalline epoxy nanocomposites including azomethine epoxy resin (AM epoxy) and biphenol epoxy resin (BP epoxy). AM epoxy resin can be prepared by adding 4-aminophenol and 4-hydroxybenzaldehyde in proper solvents such as DMF, and then purify, recrystallize and react with epichlorohydrin (EPI) in alkaline condition. BP epoxy resin can be obtained by applying 4,4'-dihydroxybiphenyl to react with EPI, using BTMA as catalyst and under stirring at 120°C, and then removing the solvent to obtain white powder and purify the products.

Surface modification of nanoparticles :

The previous method developed in our laboratory for surface modification of nanoparticle will be applied in this project. In this project, both γ -Glycidoxypropyltrimethoxysilane (GPS) and Diphenyldimethoxy silane (DPMS) will be applied as coupling agents for surface modification of nanoparticles to increase the compatibility of liquid crystalline epoxy composites.

Hybrid of organic and inorganic :

Hybrid of organic and inorganic can be obtained by solving the liquid crystalline epoxy composites in the solvent and mixing with solved nanoparticles. After that, photo initiator OPIA and photo sensitizer camphoquinone will be added and the solvent will be removed to obtain the uncured nanocomposites.

Preparation and test of post system

By using liquid crystalline epoxy nanocomposite, dental post with different diameter size either light cured or heat cured can be fabricated and compared with marketed posts including

1. Microhardness test
2. Impact test
3. Fatigue test

Preparation and test of resin cement and core system

By using liquid crystalline epoxy nanocomposite, dual cured resin

cement and core system can be fabricated.

Marketing

At present, Omega Medical Taiwan Limited is agreed to market the products.